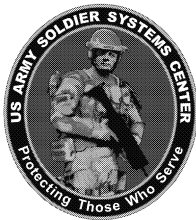


TECHNICAL REPORT
NATICK/TR-08/010



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**LAW ENFORCEMENT ADVANCED PROTECTION
(LEAP) DUTY UNIFORMS, INTEGRATED HEAD
PROTECTION, CHEMICAL/BIOLOGICAL
PROTECTION AND HUMAN SYSTEMS INTEGRATION
LAW ENFORCEMENT USER FOCUS GROUP REPORT**

by
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**CTC, Inc.
Westborough, MA 01581**

March 2008

Final Report
May 2007 – September 2007

Approved for public release; distribution is unlimited

Prepared for
**U.S. Army Natick Soldier Research, Development and Engineering Center
Natick, Massachusetts 01760-5019**

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professionals who participated in this focus group.

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PREFACE

The U.S. Army Natick Soldier Research, Development and Engineering Center (NSRDEC), conducted a Law Enforcement Advanced Protection (LEAP) Requirements User Focus Group May 15-16, 2007 in Scottsdale, Arizona. This was a collaborative effort on the part of NSRDEC, the Department of Homeland Security, Office of Science and Technology, Office of Standards (DHS-S&T), the National Institute of Standards and Technology – Office of Law Enforcement Standards (NIST-OLES), the National Institute of Justice, Office of Science and Technology (NIJ-OST), and the Center for Technology Commercialization (CTC).

This report was prepared during the period May 2007 – September 2007 under contract number W911QY-07-C-0035.

This focus group supports the LEAP Program, and is one in a series of personal protective equipment (PPE) related user focus groups for members of the law enforcement community. Its purpose was to collect data/criteria for operational requirements, PPE trends and concepts of operations (CONOPS) from representatives in law enforcement. Program participants represented a cross section of the country's law enforcement community, serving in different agencies, departments and job functions. The focus group topics were as follows:

- Duty Uniforms;
- Integrated Head Protection;
- Chemical/Biological Protection; and
- Human Systems Integration.

Focus group discussions included: PPE integration and compatibility concerns; chemical/biological (CB) PPE and systems; CB response mission roles and mission related tasks; and law enforcement duty uniforms standards related issues.

Each focus group topic discussion generated information specific to that area, including needs and threat requirements, and prioritization of needs. Significant concerns, comments and conclusions by the law enforcement professionals in topic areas were:

Duty Uniforms and their materials, style and “image” considerations are steeped in Department traditions making changes difficult. They provide little protection from chemical/biological hazards. Duty uniform design has changed little in many years and more could be done to adopt technology advances for threads, fibers and design innovations for increased protection, functionality, and comfort.

Integrated Head Protection discussions encompassed areas of tactical, motorcycle and law enforcement bicycle operations. Participants cited a lack of manufacturing standards in head protection for law enforcement as a problem area leading to significant performance differences between head protection platforms. Integrating head protection with breathing apparatus, communications systems and shoulder weapons are major difficulties.

Chemical/ Biological Protection discussions concerned personal protective equipment (PPE) cost, durability, component integration and a lack of law enforcement standards addressing manufacture, design and equipment shelf life. Participants reviewed and validated chemical/biological operational scenarios in the mission roles of perimeter control, tactical operations and crime scene investigation (CSI). They also prioritized protection needs in the chemical/biological environment.

Human Systems Integration discussions built on dialogues in prior topic areas to create a picture of environmental and climatic issues and their impact on officers, uniforms and protective equipment. These discussions highlighted current limitations and opportunities for improvement with the law enforcement officer positioned at the center of the integrated system.

Data collected through this focus group will be used with on-going research and analysis to support of a number of LEAP related activities, including developing performance criteria for law enforcement specific PPE standards. One participant offered a gauge for successful PPE integration. “When we see the deployment of scratched up and slightly worn PPE equipment, it shows wear because the PPE parts integrate and work well together. Seeing this is a measure of success, instead of seeing all fresh gear coming out that has never been used.” While frequently used and worn equipment can pose potential problems if not maintained or replaced as necessary, indications of prior use may also show what kinds of equipment have worked well in the past.

LAW ENFORCEMENT ADVANCED PROTECTION (LEAP) DUTY UNIFORMS, INTEGRATED HEAD PROTECTION, CHEMICAL/BIOLOGICAL PROTECTION AND HUMAN SYSTEMS INTEGRATION LAW ENFORCEMENT USER FOCUS GROUP REPORT

1.0 Introduction

1.1 Evaluation Objectives

The law enforcement user focus group consisted of four facilitated discussion segments. The purpose of these sessions was to further refine law enforcement needs and performance criteria in multiple personal protective equipment technology areas. The goal of this focus group was to conduct facilitated discussions on the following topics:

- **Duty Uniforms**, emphasizing the current state of protection, the need for improved uniforms and standards, identifying perceived threats, prioritizing baseline requirements, appearance needs, laundering protocols, durability considerations and integration issues.
- **Integrated Head Protection**, reviewing the current state of protection and perceived threats, and prioritizing baseline requirements, head borne capability needs, and integration issues.
- **Chemical/Biological Protection**, defining mission roles, tasks, and durations, perceived threats and prioritizing threats, wear and weathering considerations, mission related ergonomic scenarios, and integration issues.
- **Human Systems Integration**, emphasizing overarching integration concerns.

1.2 User Focus Group Overview

Subject: User focus group for members of the law enforcement (LE) community, representing various agencies and regions to discuss their needs and opinions relating to

- Duty Uniforms;
- Integrated Head Protection;
- Chemical/Biological Protection; and
- Human Systems Integration.

Location and date: Doubletree Paradise Valley Resort in Scottsdale, AZ, May 15-16, 2007

Sponsor: Department of Homeland Security, Office of Science and Technology, Office of Standards

Host Activity: The U.S. Army Natick Soldier Research, Development and Engineering Center (NSRDEC), the National Institute of Standards and Technology – Office of Law Enforcement Standards (NIST-OLEs)

Facilitator: Chief Stephen Doherty (Retired) CTC, Inc., Public Safety Technology Center.

1.3 Participants

The focus group contained 15 members of the LE community from urban and suburban jurisdictions, representing state, county and local law enforcement agencies. Criteria for participant selection included

- Active duty law enforcement or law enforcement technical support personnel;
- Agency authorization; and
- No prior participation in similar research efforts.

Additional participant selection included recommendations from the National Institute of Justice (NIJ), NSRDEC, and Edgewood Chemical and Biological Command (ECBC).

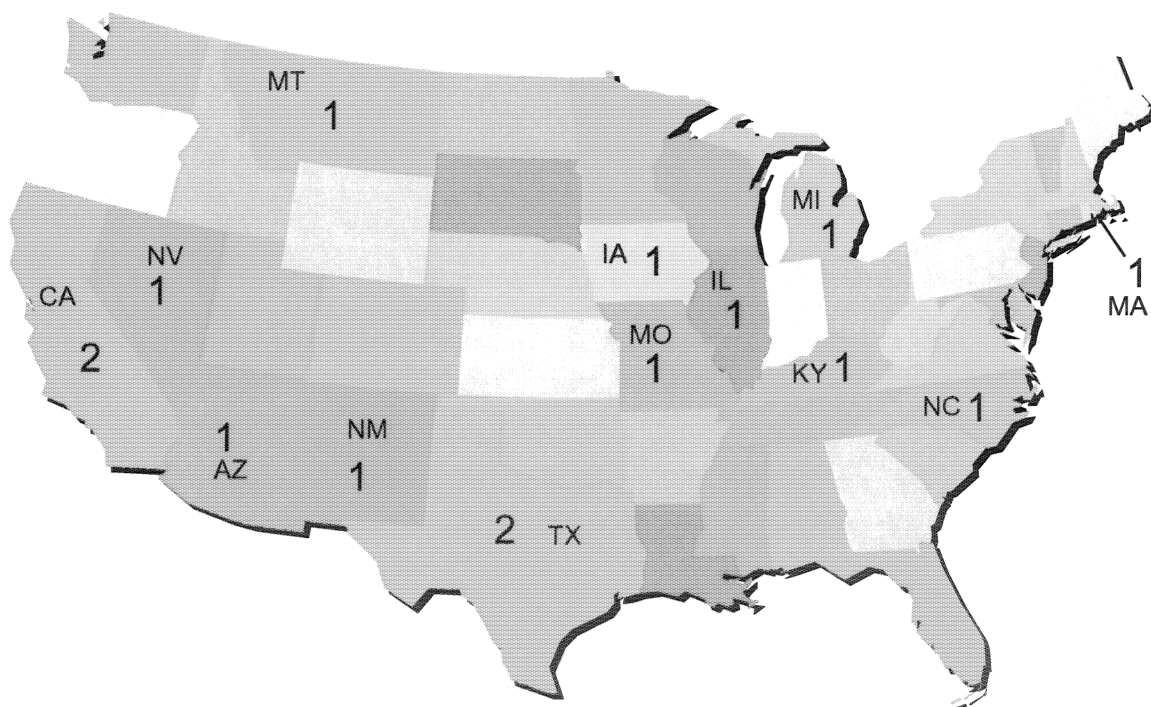


Figure 1. Law Enforcement Focus Group Geographical Profile

These law enforcement participants represented primarily the central, mid-western and western regions of the United States, as seen in Figure 1 above. Participants' experience areas and job functions included day-to-day field operations, office/headquarters personnel, tactical/specialized personnel, and forensics lab personnel. All personnel functions include activities in the chemical/biological response arena.

Table 1 represents participant background information relative to responder discipline, years of experience and home state.

Table 1. Participant Background Information

Responder Discipline	Years of Experience	Home State
Counterterrorism	6 - 10 years	CA
Tactical / Special Operations	6 - 10 years	NV
Specialized Operations	6 - 10 years	KY
Tactical / Special Operations	11 – 15 years	MA
Day to Day Field Operations / Tactical / Specialized Operations	11 – 15 years	MT
Day to Day Field Operations / WMD Instructor	More than 15 years	MO
SWAT Commander	More than 15 years	TX
Bicycle Patrol Officer	More than 15 years	NC
Tactical / Special Operations	More than 15 years	AZ
Tactical / Special Operations	More than 15 years	CA
Tactical / Special Operations	More than 15 years	TX
Criminologist	More than 15 years	IA
Office / Headquarters	More than 15 years	NM
Director of Emergency Management	More than 15 years	MI
Tactical / Special Operations	More than 15 years	IL

One representative each from NSRDEC and ECBC attended as observers for both days of the Workshop/Focus Group.

1.4 Focus Group Methodology

Focus Group Preparation

Several weeks prior to meeting, focus group participants were sent a packet of read-ahead material that included information about the group's proposed goals and discussion topics. (See Appendix C)

The read ahead material also included a 21 question survey developed by NSRDEC, for participants to complete independently and submit either electronically or in hard copy at the beginning of the focus group. (See Appendix A)

The survey consisted of quantitative, multiple choice, yes/no, and rating scale questions and included questions related to their experience and use of duty uniforms, integrated head protection, chemical/biological protection and human systems integration. Appendix B has the analyzed data and summarized results, including displayed means and frequency of responses.

Focus Group Proceedings

As previously described, participants were invited to attend after carefully considering their relevant experience and qualifications. Focus group segments were structured progressively, beginning with the basic duty uniform, and building upon a format that mirrored a reasonably anticipated law enforcement career (e.g. patrol officer/duty uniform; head protection/motorcycle; tactical/specialized- components). In a post 9/11 world, regardless of duty assignment, every law enforcement officer deals with the daily reality of encountering potential chemical/biological threats.

The focus group comprised four facilitated discussion segments. Each one addressed a particular topic: Duty Uniforms, Integrated Head Protection, Chemical/Biological Protection, and Human Systems Integration. Participants completed a short written survey at the conclusion of the Duty Uniform, Integrated Head Protection and the Chemical/Biological discussion segments to document their top integration issues. Survey results are in the body of this report, in the related discussion areas.

During the Duty Uniform and Integrated Head Protection (IHP) discussions, participants were led in an exercise to identify threat severity and frequency of occurrence. These exercises produced the "Prioritization of Protection Needs" matrices in Appendix D.

During the facilitated Chemical/Biological discussion, proposed ergonomic testing scenarios were presented for the LE mission roles: perimeter control, tactical operations and CSI. Mission roles are described in Appendix E. The scenarios proposed real world situations that represent law enforcement responses to a CB incident. (See Appendix F) Participants were asked the following questions, noting that all tasks are performed within a CB environment:

- Do the proposed scenarios accurately represent reasonably anticipated tasks?
- Are the tasks within each scenario reasonable or unreasonable?

- Is the task sequence accurately represented?
- Are any tasks missing?
- Do tasks accurately reflect an officer's response?

Results of the exercise are in the related discussion areas in the body of this report.

During the Chemical/Biological Protection discussion, participants were given a list of frequently performed physical activities, and asked if these activities applied to Perimeter Control, Tactical Operations, and CSI mission roles. After responding, the group compared their results with the responses of a previous focus group held in Arlington, Virginia, November 15-16, 2006, and discussed differences. The Arlington group's detailed discussion and conclusions are in the May, 2007 report, "Law Enforcement Advanced Protection (LEAP) Requirements Focus Group." This analysis provided a mechanism to discuss discrepancies and areas of conflict between the two different focus groups.

Participants were also asked to validate frequently performed physical activities in three scenarios within Perimeter Control, Tactical Operations, and CSI mission roles. Results of this exercise are in the body of this report, in the related discussion area.

1.5 Focus Group Strengths and Limitations

Focus groups can be an effective tool to

- Collect attitudes and experiences supported by qualitative information;
- Identify existing issues or problems with respect to products or policies;
- Explore ideas and concepts; and
- Generate discussion for new ideas and solutions.

Witnessing interactions and evolving opinions from participants with various investments in a concept are underlying strengths of focus groups. Through these interactions, researchers hope to gain insights into user habits and preferences, which would otherwise be less accessible.

Focus groups have limitations in that they may not produce quantifiable and/or statistically significant data. Due to the small number of participants, results should not be generalized as representative of a larger community. Also, it should be noted that ideas generated in focus groups are the views of individuals who may or may not always agree. Though in some cases, the group may reach a consensus; this should not be the expectation.

Discussion summaries in this report attempt to represent all views expressed, and note when opinions differ. Finally, due to the nature of focus groups, it can never be guaranteed that participants will express their viewpoints on all intended topics or follow a planned agenda. Though the facilitator tactfully guided the group and kept the

discussion on course, participants were not discouraged from speaking their minds or voicing outside concerns they felt were relevant.

2.0 Focus Group Discussion Results

2.1 Facilitated Discussion: Duty Uniform

Objective: For each participant to describe their current duty uniform and discuss what, in their opinion, are the positive and negative features of that uniform. Participants discussed whether or not there is a need for a duty uniform standard, and identified a list of needs for a new duty uniform.

NSRDEC began the focus group discussions by presenting the “human centric” approach to protecting soldiers and how it relates to law enforcement in NSRDEC’s Law Enforcement Advanced Protection (LEAP) Program. The presentation provided a framework for the facilitated duty uniform discussion, which included the following topic areas:

- Current State of Protection;
- Need for Improved Duty Uniforms and Standards;
- Perceived Threats;
- Appearance Needs;
- Laundering Protocols;
- Durability Considerations; and
- Duty Uniform Integration Concerns.

2.1.1 Current State of Protection

A law enforcement duty uniform is the most basic agency required personal protective equipment. The duty uniform is the first layer of defense for every arriving officer. Typically, the first responder does not have the opportunity to don additional protective equipment, as threats and hazards are not always known or identifiable at the time of arrival. The duty uniform is the only PPE component global in its application.

To address the current state of protection provided by duty uniforms, participants first discussed materials used, then segued into climate differences and basic uniform classes required for a law enforcement officer. Discussions centered on duty uniforms for assignments most commonly required of law enforcement officers. These included automobile, motorcycle and bicycle patrols.

Materials used for duty uniforms by attendees included:

- Coolmax®
- Cotton
- Leather
- Nomex®
- Polyester-cotton blend
- Rayon
- Wool

Numerous participants, representing different agencies reported that decision-making about duty uniform type is done through a committee in the agency that determines all details, including material, style, and appearance. The committee even specifies where equipment will be placed on a duty belt. The group made it clear that uniform committees greatly influence duty uniform selections and choices. However, they concurred that the final decision rests with the Chief, Sheriff or similar individual's command authority. They also agreed that their agencies decide when a mandatory universal changeover of patrol personnel's duty uniforms (i.e. short sleeve to long sleeve) takes place in the calendar year.

Discussions about the current state of LE duty uniforms produced general agreement on four significant points:

- The core patrol duty uniform of shirt and trousers is steeped in individual agency tradition and has remained basically unchanged for many years.
- A rigid committee system that regulates duty uniform changes exists in many Departments.
- Cost is a significant factor in acquiring initial sets of duty uniforms for some departments. After completing basic academy training, participants concurred that on average officers received anywhere from \$4,000 to \$7,000 to cover their initial duty uniform expenses. However, PPE costs can easily exceed the allotment, and departmental allowances vary widely. (A representative purchase order sample provided by the Albuquerque Police Department is in Appendix G.).
- Concern with appearance (as judged by each agency) of duty uniforms especially surrounding "military looking" uniforms, ranked high in influencing duty uniform decisions. The majority of participants agreed that in their department, the decision-makers did not favor an overly militaristic appearance for everyday use patrol uniforms.

2.1.2 Need for Improved Duty Uniforms and Standards

The agencies participating in the focus group represented a wide variety of law enforcement duty uniform styles, colors and materials. Participants generally agreed that current duty uniforms, with the exception of body armor, provide little if any protection from threats. Focus group participants' universally desired improved protection built into duty uniforms.

While the group desired increased protection from threats, it was also concerned that improved protection built into duty uniforms would be unsuccessful or haphazard at best,

without having standards to measure and define performance. The present state of duty uniforms, without standards to guide selection leaves uniform vendors to produce equipment with unquantifiable performance.

2.1.3 Perceived Threats

Focus group participants generally wanted duty uniforms to provide greater protection from threats, but they also required greater specificity of threats. Participants were asked to detail the types of threats they wanted their duty uniform to protect against as indicated by the following:

- Biological hazards;
- Chemical hazards;
- Blood borne pathogens;
- Environmental Elements:
 - Temperature extremes
 - Ultra-violet rays (provide SPF protection)
 - Moisture repellency
- Thermal flash/flame hazard;
- Static electricity (Taser™ use against officer);
- Ballistic threats (eliminate body armor); and
- Puncture/slash/stab threats (including dog bites).

2.1.4 Appearance Needs

Participants generally agreed that there is widespread concern about how the duty uniform appears, and how an officer's "image" is perceived. Participants made the following comments concerning duty uniform appearance and image needs:

- **Instant Identification:** The duty uniform must provide instant identification as a law enforcement officer to civilians and other emergency responders;
- **Professional Appearance:** The uniform must be "sharp." Professional appearing officers are assaulted less often.
- **Police Presence:** The first use of force is your police "presence" provided by uniform appearance;
- **Approachability:** Uniform appearance helps make officers "approachable" for community policing initiatives;
- **Functionality:** The duty uniform must allow mobility, climbing, running without ripping or tearing;
- **Uniform Hat:** Emphasis on always wearing the duty uniform hat for image purposes may jeopardize officer safety, though there can be disciplinary measures for not wearing your uniform hat;

- **Uniform Culture:** Law enforcement periodicals' such as "Best Dressed Lists" are driven by appearance instead of practicality; and
- **Duty Uniform Hazard:** A white t-shirt worn under a dark uniform shirt creates what participants termed, "the triangle of death," as it provides a target for assailants.

2.1.5 Laundering Protocols

The duty uniform requires maintenance through either home laundering or dry cleaning. Participants expressed various opinions on methods to keep their uniforms clean. One reported that contact with blood requires the uniform be disposed of since it is considered biologically contaminated.

Additional laundering comments included the following:

- **Laundering Convenience:** Laundering is not a concern - "We leave them at the station and they are returned cleaned and pressed." With regard to home care, some uniform shirts require ironing to look their best, but there are officers that will wear them without ironing.
- **Laundering Policy:** One participant noted that in cases where exposure to a blood borne pathogen occurs, the agency pays for the uniform replacement. Another participant suggested that it would be helpful to have standardized cleaning methods mandated (i.e. dry-cleaning is required for everyone), to maintain a consistent appearance. Another participant described the quartermaster system, where the department provides all the uniforms, and the watch commander subjectively determines when uniform replacement is required.
- **Dry Cleaning Expense:** If dry cleaning costs are not covered by the agency, they can be significant when dry cleaning is adopted by individual officers.
- **Ease of Care:** Polyester requires the least amount of effort to look good; and
- **Comfort:** Cotton needs to be pressed, but it is more comfortable than polyester.

2.1.6 Durability Considerations

Participants reported that duty uniform durability was heavily affected by laundering methods, and vice versa. Several participants agreed that dry cleaning prolonged duty uniform life over wet washing/drying treatment.

While discussing durability, respondents returned to issues of duty uniform "image" and appearance. These closely intertwined concerns were expressed by the following responses:

- **Fading:** Laundering increases speed of duty uniform fading; and
- **Material “sheen”:** Home laundered garments develop a noticeable sheen in the material.

When asked, “What determines comfort for you?” and “what comfort factors are important?” the group responded:

- **Breathability:** Sweat/moisture wicking for cooling (i.e. Tac Wear and UnderArmor®; once cotton is wet, it stays wet); and
- **Range of Motion:** having peripheral vision while driving, having full mobility when arresting someone, and scaling walls during a foot chase.

Participants were also asked if they would consider trading weight reduction in their duty uniform for increased protection. Their comments on this trade-off are below:

- **Common Problem:** Many will trade comfort over protection when the duty uniform ballistic vest is considered too heavy or bulky.
- **Temperature Extremes:** Nomex® is extremely hot, and in climates where heat exhaustion is a common problem, it is difficult to wear for long time periods.
- **Trade-off Risks:** While many prefer comfort, such as fabric breathability like Under Armor®, risk factors involved may create life-threatening situations. One participant noted that Under Armor® “shrink wraps” to the wearer’s skin when exposed to fire.
- **Trade-offs not Necessary Anymore:** Two participants commented that technology has advanced to the point where trade-offs are no longer necessary, citing their vests are lightweight and comfortable.
- **Tactical T-shirts:**
 - The military has created a moisture-wicking cotton t-shirt that holds up during laundering and does not stretch out. (*Note: The participant did not provide mil-spec number.*)
 - Charcoal barrier: PROTECH® makes a shirt with a charcoal coating that creates an antibacterial barrier (even after a month of not washing, there was no odor).
 - Silver metal barrier: a participant reported testing a Medalist® t-shirt made of a fiber with a layer of real silver permanently bonded to it. Silver is antibacterial, anti-odor, and anti-static.

2.1.7 Duty Uniform Integration Concerns

For the facilitated discussion concerning duty uniform integration, participants commented on issues about integrating numerous duty uniform components:

- **Layering:** Multiple layers of thick materials worn in cold weather cause loss of mobility and inhibits access to duty belt equipment. All jackets and rain coats cause some degree of hindrance. Some officers overcome this integration issue with under layers instead of over layers.
- **Jacket Design:** One participant noted that the jacket issued by the department accommodates access to the duty firearm, but when zipped inhibits access to all other duty belt equipment.
- **Duty Belt Design:** Equipment required to be carried on the duty belt is increasingly being mandated. Depending on the wearer's size, the equipment may not fit on the belt. The weight of the equipment, once added, is a hindrance to some.
- **Body Armor:** Participants from Chicago and St. Louis indicated adopting an exterior vest that is identical in appearance to a standard duty uniform shirt.¹ Its first feature visually integrates body armor with the department's uniform. Its second feature alleviates the load carriage concerns mentioned previously, as it allows the wearer to move equipment up to the vest and off the duty belt. However, one participant commented that, although visually attractive, exterior body armor creates handholds at the shoulders that an assailant may grab to overpower the officer.

2.1.8 Prioritization of Protection Needs – Exercise Results

The group was presented with a threat matrix, and was asked to describe where their duty uniform needs fit in relation to threat levels and frequency of occurrence. The horizontal axis represents the potential frequency or likelihood of threat occurrence. The vertical axis represents the range in severity of the potential threat, up to and including death. As seen in Table 2, participants identified the greatest risk, with highest frequency, as being a firearms-related threat. The highest level threats indicated, following “gunshot,” were:

- Weaponized Chemicals (less likely than “gunshot,” but with a potentially catastrophic outcome); and
- Blood borne Pathogens (frequent occurrence and potentially critical outcome).

¹ The exterior vest cover maker referred to by two focus group participants was J.G. Uniforms (www.jguniforms.com) of Chicago, Illinois.

Table 2. Prioritization of Protection Needs

Prioritization of Protection Needs						
Severity of Risk	Category	Frequent	Likely	Occasional	Seldom	Unlikely
	Catastrophic - May result in death	Gunshot ¹	Weaponized Chemicals		Weaponized Chemicals	
	Critical - may cause severe injury, major property damage, significant \$ loss	Blood borne Pathogens ²	Industrial Chemicals ³ Puncture/Slash ²		UV Threat Protection - CUMULATIVE Environmental ² (frostbite example) Flame Protection	
	Marginal - May cause minor injury, illness, property damage, \$ loss	Industrial Chemicals ⁴ Blood borne Pathogen ²				
	Negligible - hazards present a minimal threat to safety, health, and well-being of involved personnel	Environmental	UV Threat Protection - IMMEDIATE			
Risk Levels		Extremely High	High	Medium	Low	

DEFINITIONS:

Industrial Chemicals - lawfully held

Weaponized Chemicals - not lawfully held; WMD event

Biologicals - someone's blood or cut on someone's arm

UV Threat Protection - can be "cumulative" or "immediate"

¹ Gunshot-Catastrophic, but frequency depends based on population size and environment (urban/suburban)

² Have to view this from a geographic perspective, as threat probability changes based on location; is also event-driven

³Special considerations: Football season; small nuclear reactor on campus; accidental exposure as weapons degrade

⁴Hazardous incident risk/winds coupled with cargo accident rail/highways, risk of accidents (ex: Ann Arbor - surrounded by highways, gas lines that come through communities; super pipelines)

2.1.9 Duty Uniform Integration Issues – Survey Results

A brief paper survey was distributed to focus group participants at the conclusion of the facilitated duty uniform discussion. For the survey, they were asked to prioritize their top five duty uniform integration issues from one to five, with one being the greatest duty uniform integration issue, two being the second greatest issue, and so on. Responses were tallied into several specific protection categories, shown in the following table. In Table 3 below, a weighted sum score is also shown, applying different weights to the five ranks to give an overall score that represents the participants' opinions. Frequency and average ranking for each integration issue area are also listed. This survey was completed by 14 of the total 15 participants.

Table 3. Duty Uniform Integration Issues – Survey Results

	Frequency	Avg Rank ¹	Weighted Sum ²
Comfort	11	3.36	37
CB Protection	10	3.00	30
Appearance	7	4.29	30
Environmental	8	3.50	28
Access to Equipment	7	3.71	26
Durability	9	2.67	24
Proper Fit	4	1.75	7
Compatibility	1	5.00	5
Other ³	1	4.00	4
Alternate "suit"	1	3.00	3
Load Capacity	1	1.00	1
Conductivity ⁴	1	1.00	1

¹Participants prioritized needs by ranking them from 1 to 5 (1= Greatest Integration Issue)

²Weighted sum is determined by applying weight to each rank and computing the sum. Weights: 1st=5 pts, 2nd=4 pts, 3rd= 3 pts, 4th=2 pts, 5th=1 pt. Greater weighted sum indicates higher group ranking.

³One participant indicated National Incident Management System (NIMS) as a duty uniform integration issue; no further specificity was provided and therefore this was classified as "Other."

⁴One participant reported "electrical threats: Taser®, live wires," which is classified as Conductivity above.

Overall, comfort and CB Protection were identified as the greatest integration issues for any duty uniform. Comfort was the most dominant response, with 11 occurrences. The weighted sum of 37 indicates the group's ranking in terms of importance was highest for comfort as well. CB protection was listed 10 times, and Durability was cited 9. Appendix H has a more detailed summary of these integration issues.

2.2 Facilitated Discussion: Integrated Head Protection

Objective: For each participant to describe their current head protection, perceived threats, and baseline requirements for protection.

The discussion on integrated head protection was preceded by presenting a visual display of Figure 2 depicting Integrated Head Protection as: “A System of Sub-Systems” comprising the following component areas:

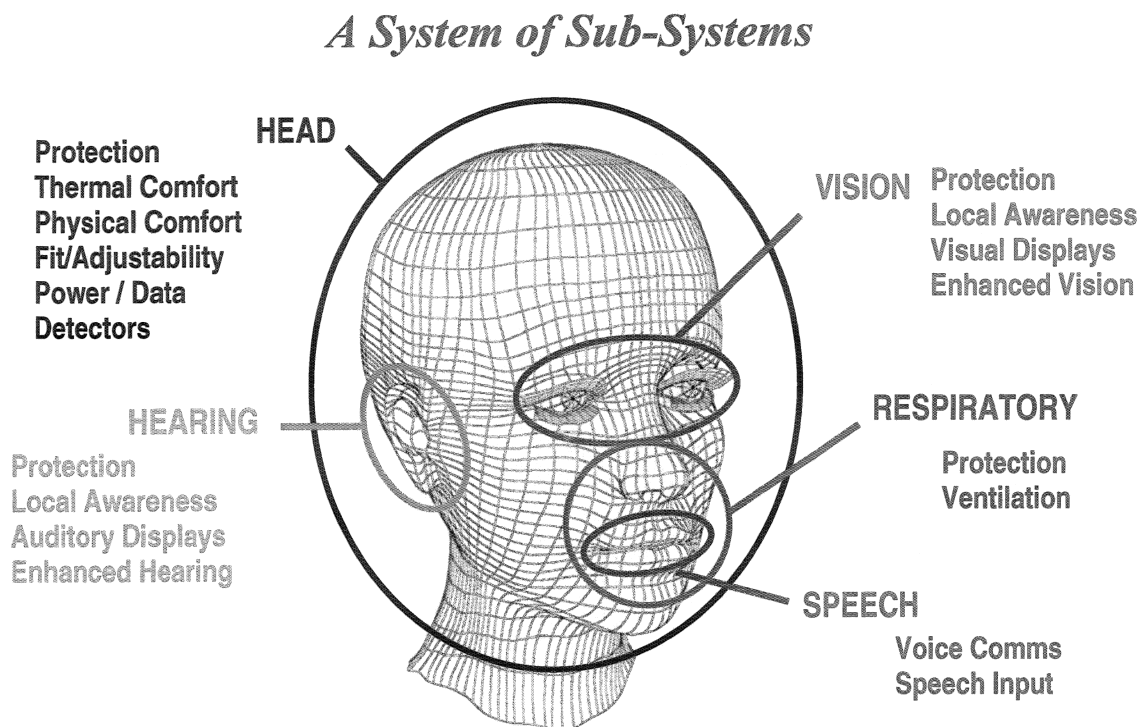


Figure 2. A System of Sub-Systems

2.2.1 Current State of Integrated Head Protection

The discussion on the current state of head protection for LE personnel included candid comments by participants regarding their experiences wearing different types of head protection. The tactical area of law enforcement operations while wearing head protection included the following experiences:

- **Backface Deformation:** One participant was using surplus military head protection, which when live fire-tested, had rounds that penetrated the head protection. The “trauma bubble” created in the head protection in tests would have been devastating to the wearer.

- **Comfort/Protection Trade-Offs:** Another participant stated they use Second Chance[®] Level III² helmets that were selected for their ballistic protection. However, the officers take off the face protection because it's not cool (both in temperature and perception of the wearer). It provides no ventilation and fogs up depending on the climate and time of year.
- **Communications Degradation:** Officers also reported diminished ability to give voice commands as the face shield comes way down and is designed to protect the throat.

Participants described the current state of head protection for motorcycle and bicycle officers as being similar to each other, but differing from tactical head protection. The leading concerns for motorcycle officers' head protection were protection from crash/trauma impact, good visibility and effective communications. Bicycle officers' head protection concerns were also led by crash/trauma impact. However, their next priorities were temperature and ventilation. Additional protection comments included:

- Motorcycle communications require wires that are external to head protection, and connect to the radio system.
- Bicycle helmets do not provide enough ventilation.
- There is no standardized "law enforcement" bicycle helmet.
- Many officers use motorcycle helmets when deployed to crowd control situations.

One "state of integrated head protection" concern voiced by many participants was suspension systems used to suspend and secure head protection. Participants considered these systems problematic, though fundamental to officer protection as loss or removal of head protection in tactical, motorcycle or bicycle operations could result in catastrophic injury.

² We understand that the NIJ Standard 0106.01 for Ballistic Helmets contains no Level III protection type, but the comment is a direct quote from the focus group, left in to maintain the integrity of the data collection in the context it was made.

2.2.2 Prioritization of Protection Needs – Exercise Results

The group was presented with a threat matrix, and was asked to describe where their head protection needs fit in relation to threat levels and frequency of occurrence. The horizontal axis represents the potential frequency or likelihood of threat occurrence. The vertical axis represents the range in severity of the potential threat, up to and including death. As seen in Table 4, participants identified the greatest risk, with highest frequency, as being temperature related threats.

Table 4. Prioritization of Protection Needs – Exercise Results

Prioritization of Protection Needs

Severity of Risk	Category	Frequent*	Likely	Occasional	Seldom	Unlikely
	Catastrophic - May result in death	Temperature Protection ¹		Impact – Crash	Impact - Ballistic	
	Critical - may cause severe injury, major property damage, significant \$ loss	Vision Protection ²	Hearing Protection Impact - Objects ³			
	Marginal - May cause minor injury, illness, property damage, \$ loss					
	Negligible - hazards present a minimal threat to safety, health, and well-being of involved personnel					

Risk Levels

Extremely High

High

Medium

Low

*Frequency may vary based on geographic area...urban areas - more potential for frequency of occurrence than non-urban areas.

¹ Can impact tactical mission if operator goes down; mental acuity suffers prior, and partner steps in to assist

² Vision protection should be married to helmet design.

³ Should be modular to allow for flexibility, based on environment/mission.

2.2.3 Head-Borne Capability Needs vs. Wants

In addition to the helmet platform, and within the concept of a head protection system of sub-systems, participants were asked to identify their needs and wants for additional head-borne capabilities.

Participants covered a broad spectrum of head-borne capability needs, which included protection from:

- Impact/Blunt Trauma Protection - Pavement/crash protection;
- Ballistic;
- Thrown Objects;
- Fire Impact - civil disturbance perspective (Molotov cocktail);
- Bio-Hazards - civil disturbance environment;
- Hearing Protection - Peltor® type noise reduction from gunshots, flash bangs;
- Eye Protection - Vision Protection;
- Respiratory Protection Fit - provide for face seal; and
- Thermal Threat - need for temperature stabilization – active venting or active cooling that circulates fluid through the helmet to regulate temperature extremes. Helmet temperature in Scottsdale can be up to 130° F. The opposite applies for northern climates in extreme cold.

Participants were asked to discuss a head protection “wish list.” One participant responded that hearing flexibility was a priority, stating that venue may determine hearing requirements. In the wilderness you want acute hearing, but in an urban environment that same level of hearing acuity, within the head protection may be too much. The suggestion of head protection flexibility was seconded by another participant who framed it as requiring “modularity.” He suggested that to him, head protection “modularity” meant the desire for “plug and play” flexibility, based on venue and threat protection levels.

When asked what capabilities are required to integrate with the helmet platform, participant responses were as follows:

- Communications must be integrated with the helmet platform;
- Eye protection should be integrated with the helmet and not conflict with communications;
- Respiration systems must work with head protection, and not cause a conflict:
 - Self-contained Breathing Apparatus (SCBA)
 - Powered Air-purifying Respirator (PAPR)
 - Air-purifying Respirator (APR)
- Suspension and securing of head protection must accommodate comfortable breathing and face seal, and not conflict with firing a weapon;
- Provision of helmet lighting (modular/as needed for confined space entry/ tubular environment or explosive/mechanical breaching); flip up light when you need both hands; either infra-red (IR) or white light; and

- Helmet mounted camera is desirable (tactical entries are recorded to document threat levels) similar to a Taser[®] camera.

Several participants raised the need to establish LE specific standards for head protection and related protection elements within the head protection “system.” One participant characterized as “multi-level,” the issue of a lack of standards. Existing head protection standards for law enforcement are limited to ballistic protection. Nowhere do existing standards address the participants numerous needs and wants in tactical, motorcycle and bicycle officer head protection areas.

Several participants reported that manufacturers provide products without standards, fitting them to wearer(s) independently, and that significant fitting and sealing issues exist between head protection and many types of breathing equipment. Lack of guiding standards, compounded by manufacturers operating independently of each other, is a recipe for incompatibility.

2.2.4 IHP Integration Concerns

The integrated head protection discussion was conducted by perceiving the head environment as a “system of sub-systems,” and it generated significant comments, particularly pertaining to integration.

The suspension and strap system for head protection was a major concern. Weight and balance shifting of head protection can immediately affect integration and effective operation of other PPE elements. The more functionality added to the head protection platform, i.e. night vision equipment, headlamps, etc., the more critical head protection suspension, balance and securing structures become.

Specific head protection integration comments provided by participants were as follows:



- Helmet suspension systems do not provide capacity for increased weight in front (i.e. the addition of night vision equipment, lights, cameras, etc.).
- Helmets prevent getting a good “cheek weld” when firing a shoulder weapon.
- Suspension straps do not integrate well with ear pieces.
- Securing the helmet strap while wearing APR is very difficult.
- The head protection face shield makes wearing APR impossible; the face shield must be removed.
- Current head protection systems make it difficult to maintain a proper APR face seal; the slightest movement can result in the loss of the APR face seal.
- Weapon sighting is very difficult while wearing a head protection face shield;
- Head protection face shields fog up with condensation.
- Communications while wearing tactical helmet are a constant problem.

Participants were asked to provide ideas and suggestions to correct, or at least mitigate some of the head protection integration problems they cited. Suggested improvements follow:

- Protective headgear, form-fitted accurately to the individual so it provides customized suspension would not require a chin strap;
- Face shield or face protection that retracts into the helmet body, perhaps between layers, and can be raised or lowered as needed for accurate weapons sighting; and
- User configurable “modularity” for head protection additions, that have universal mounts can permit agencies to select mission-specific equipment while reducing costs.

One participant reported some degree of success with head protection integration. He successfully used a fire helmet for head protection that had great communications capability, integrated well with SCBA and accommodated an add-on light. This agency purchased law enforcement SCBA to match that of their Fire Department. If the Fire Department supports law enforcement, he knows his SCBA is compatible with their equipment. This participant also recognized that despite its apparent head protection and equipment integration advantages, the Fire Department helmet was tactically unsound and provided only limited ballistic protection.

2.2.5 Integrated Head Protection Integration Issues – Survey Results

All 15 participants completed a brief paper survey at the conclusion of the facilitated IHP discussion. They were asked to list their top five IHP integration issues, ranking them from one to five, with one being the greatest IHP integration issue, two being the second greatest issue, and so on. Their responses were tallied into several specific protection categories, shown in Table 5. A weighted sum score is shown in the table below, applying different weights to the five ranks to give an overall score that represents the participants' opinions. Also shown is the frequency and average ranking for each integration issue area.

Table 5. Integrated Head Protection Integration Issues – Survey Results

	Frequency	Avg Rank ¹	Weighted Sum ²
Head Protection to CBRNE Gear Fit	15	3.47	52
Communications	10	3.40	34
Suspension- Harness	7	4.43	31
Eye Protection	9	3.11	28
Standardization of Add-Ons	6	2.50	15
Impact Protection	3	4.00	12
Ballistic Protection	2	4.50	9
Hearing Protection	5	1.40	7
Environmental	2	2.50	5
Head Protection to APR Fit	1	5.00	5
Weight	1	4.00	4
Head Protection Fit	1	2.00	2
Adaptability (i.e. from Bike to Riot gear)	1	1.00	1

¹Participants prioritized needs by ranking them from 1 to 5 (1= Greatest Integration Issue)

²Weighted sum is determined by applying weight to each rank and computing the sum. Weights: 1st=5 pts, 2nd=4 pts, 3rd=3 pts, 4th=2 pts, 5th=1 pt. Greater weighted sum indicates higher group ranking.

The fit between head protection and CBRNE Gear led in frequency of occurrence and average rank (prioritization level). All participants mentioned the issue in their survey responses, and it was given a high priority. Communications was also a top priority integration issue with the group, as were Suspension, Eye Protection and Standardization of Add-ons. Appendix I has a more detailed summary of these integration issues.

2.3 Facilitated Discussion: Chemical / Biological Protection

Objective: For each participant to describe what integration problems exist in chemical biological personal protective equipment, to describe their current CB equipment and discuss its positive and negative features.

The discussion on chemical/biological protective equipment focused on the Perimeter Control, Tactical Operations and CSI mission roles. (Mission roles are described in Appendix E).

2.3.1 Chemical/Biological PPE Integration Issues

Focus group participants represented many different agencies and used PPE from various manufacturers. The integration discussion sought responses about how PPE components worked together. By consensus, participants quickly offered that piecemeal manufacturing and assembly of a complete PPE ensemble from independent components presents significant integration challenges.

Lack of Law Enforcement Specific Standards – Participants agreed universally that the biggest PPE integration issue law enforcement faced is having duty items built to National Fire Protection Association (NFPA) standards and applied to law enforcement. Participants identified the need for creative solutions to adapt and improvise existing fire service standardized equipment to their own mission roles.

Issues demonstrating the need for law enforcement specific PPE standards included:

- Body Armor/SCBA Incompatibility: One participant overcame an issue associated with using a single piece ballistic load bearing vest with SCBA or PAPR. To overcome this integration conflict, the participant modified the vest by adding a Modular Lightweight Load-carrying Equipment (MOLLE) attachment system to the back of the vest.
- Shoulder-fired Weapons/SCBA Incompatibility: Another participant mentioned that the shoulder strap (that secures the tank to the SCBA) interferes with proper positioning of shoulder-fired weapons.
- PPE Equipment Positioning – Current PPE lacks easy access to LE-specific equipment, and there is a desire to innovate in this area. Many participants find positioning and accessing equipment while wearing a CB ensemble a challenge. Suggestions included over-suit MOLLE vests.
- SCBA Tanks – The SCBA tank designed for the fire service is large. Law enforcement missions requiring SCBA would be more flexible using mission-scalable solutions. One participant mentioned a recent agency purchase of a hybrid system (military-designed Patriot® system). It has a PAPR and a one-hour bottle with a sensor to continually monitor the atmosphere.³

³ For longer missions done in chemically and biologically contaminated areas, the Patriot®—a hybrid system manufactured by Wilcox Industries Corp., combines open- and closed-circuit breathing systems, and allows

- Helmet/SCBA - Integrating the SCBA mask with the helmet system is a problem. Helmet seating and proper mask fit are significant concerns. Donning the helmet while wearing SCBA hinders fastening the chin strap and compromises the forehead edge of the mask fit. One participant suggested integrating cooling technology into the head protection system.
- Compatibility – Several participants described purchasing equipment from different manufacturers and assembling a “mix and match” ensemble in fashion. In the absence of law enforcement specific standards, the fit suffers. One participant noted, “We buy a lot of equipment that just sits in boxes. We tested it out, but depending on the situation, we’ll use something else. Now we have a trailer full of incompatible equipment.” No one has required manufacturers to develop PPE components compatible with each other. Separate CB PPE items are developed and work well independently, but integration problems arise when they need to be joined as a system.

Additional integration issues include:

- Communications –Voice amplification beyond the CB ensemble is challenging when issuing simple voice commands to assist or control civilians. While communicating with team members and the command post is possible, communicating with suspects, victims and crowds (for crowd control) is difficult.
- Proper Fit Basics - PPE integration begins with proper fit. Stores carry sizes S, M, L, and XL – one participant asked why manufactures do not produce PPE garments in more customer-friendly sizes, similar to retail stores?
- Seal Between Boot and Pant Leg – Participants expressed concerns about using tape to seal the pant leg to the boot. They described compromising the suit when the tape used to create the seal was removed.
- Electromagnetic Pulses (EMP) – Participants stated that they tend to get so wrapped with electronics that they forget there are threats from electromagnetic pulses (EMPs) that can render useless all of the equipment, including electronic SCBAs.
- Telemetry – One participant suggested an affordable telemetry system that transmits information back to command about the atmosphere the officer is walking through, and the remaining amount of air.

2.3.2 Mission Role Task Validation – Exercise Results

During the Chemical/Biological Protection discussion, participants were presented a list of frequently performed physical activities and were asked if these activities applied to Perimeter Control, Tactical Operations, and Crime Scene Investigation (CSI) mission roles. After completion, the group compared their results to those of the focus group held in

users to switch back and forth between modes depending on their needs. Unlike closed-circuit breathing systems, open-circuit breathing systems contain compressed air in a breathing bag that is inhaled by the user and expelled from the system—thus draining the air supply. The Patriot® gives users the choice of open- and closed-circuit systems. Users can either power it by using their own air, or they can use the air stored in its 2.5 liter breathing bag. The Patriot® can perform for up to eight hours in contaminated environments without needing service. http://www.military-medical-technology.com/print_article.cfm?DocID=1992

Arlington, Virginia, November 15-16, 2006, and discussed differences. (Appendix J contains the matrices from Scottsdale and Arlington).

Results of the comparison between the Arlington, VA and Scottsdale, AZ focus groups are detailed below:

- **Weapons Proficiency/Weapons Retention/Fire and Movement/Engaging Moving Targets (CSI):** While the Arlington group agreed that these tasks were required for the CSI mission role, the Scottsdale group's viewpoint differed, and it did not reach a consensus. Factors contributing to the mixed response in Scottsdale included:
 - The presence of a civilian full-time crime scene investigator (i.e. weapons are not carried by civilian crime scene investigators).
 - The opinion that once the scene is "secure," only evidence collection should take place, regardless of being sworn or non-sworn.
- **Ground Fighting – Hand-to-Hand (Tactical Operations):** The Scottsdale group contended that ground fighting was less likely in a CB environment, as the threat of hand-to-hand combat represented a lethal threat (i.e. a tear or suit breach may result in fatal contamination to the officer), thereby warranting application of deadly force. This opinion was countered by other officers who indicated their departmental policy would not sanction such action. Others discussed situations in which a victim may not have ill intent, but that panic and distress caused by the scene (and an officer wearing SCBA) could create hostility. The Scottsdale group stated that the definition required clarification, suggesting that "ground fighting" should be defined as "someone who comes on scene and challenges us to a fight; it is adversarial in nature from the beginning."
- **Self-Defense (CSI):** Two of the Scottsdale participants said that self-defense was required for CSI, but the majority of the group and the non-sworn crime scene investigator stated that it was not necessary (The Arlington focus group concluded it was not necessary). Those that considered self defense a required task held the opinion that awareness training (about self defense) was necessary.
- **Evacuation, Site Security (CSI):** Evacuation and site security topics led to lively discussions and differences of opinions. While the Arlington group concluded that neither was required for CSI, the Scottsdale group discussed the possibility that something may be missed in securing the scene, and evacuation would be necessary. One participant argued that this was the exception to the rule, and the exercise is to define "normal" requirements. Yet another participant said "evacuation" refers to evacuating the public, not personnel on-scene. A Scottsdale participant highlighted the fact that today's crime scenes are not like yesterday's. While investigating a scene where an improvised explosive device (IED) went off, another one may be missed. The prevalence of terrorist

incidents may be changing our definition of what is “normal.” Lastly, in the area of site security, one participant noted that crime scene investigators may be required to secure the site from others with badges or status, including mayor’s orders. He acknowledged that while this is less in a CB environment, it may still be necessary and it is the responsibility of the CSI personnel to provide site security in the hot zone.

- **CBRN Sampling/Monitoring (Perimeter Control):** While the Arlington group concluded that CBRN Sampling/Monitoring was required for perimeter control, the Scottsdale group’s opinions varied. Two participants from larger departments described that the responsibility for monitoring and adjusting the perimeter was done by outside parties (i.e. a special team, or the fire department) in communication with the command post. The perimeter is flexed based on atmospheric monitoring and computerized plume modeling. Other participants, from smaller departments, described pager monitors on the duty belts of the perimeter personnel, and contended it was a first responder responsibility. The group concluded that in a CB environment, a lot of resources will be called on, but until they show up and relieve the first responder of their role, it may be necessary for the first responder to take on monitoring responsibility.
- **CBRN Evidence Collection (Tactical Operations):** The Arlington focus group determined this was an essential task; however, the Scottsdale group was again, divided. One participant noted that the training enabled their tactical team to obtain guidance through discussions with the lab technicians, as to how to deploy in a CB environment. Another participant noted that they prefer Special Operations to be cross-trained, so civilians don’t have to be involved.
- **CB Perimeter Characterization/Identification of Threat:** The Scottsdale Group was troubled by the task definition and discussed adding or replacing it with a new task entitled, “**CB Perimeter Landscape Characterization**,” defined as the awareness of what the threat concerns are relative to the landscape (i.e. where the water is flowing, etc... “You don’t want to be downstream of that.”).

The exercise to validate law enforcement tasks within a chemical biological environment was productive. Practitioners confirmed, through discrepancies in their responses, the reality and complexity of performing law enforcement duties while wearing PPE. Comparing practitioner responses between the focus groups in Scottsdale, AZ and in Arlington, VA yielded interesting results.

The task validation responses between groups overwhelmingly agreed; differences were principally in the CSI role. These differences centered on the requirement for task aptitude in weapons proficiency, weapons transition, fire and movement and engaging moving targets while conducting CSI duties. The Arlington focus group supported the position that crime scene investigators should be proficient in these skill areas, even while conducting a CSI in a chemical biological environment.

In contrast, the Scottsdale focus group posited that CSI in a chemical biological environment, in an area previously checked and secured by others of any hostile adversaries, makes weapons related tasks unnecessary for crime scene investigators.

2.3.3 CB PPE Integration Issues – Survey Results

A brief paper survey was distributed to focus group participants at the conclusion of the facilitated CB PPE discussion. It requested that participants list their top five CB PPE integration issues, ranking them from one to five, with one being the greatest CB PPE integration issue, two being the second greatest issue, and so on. Responses were tallied into several specific protection categories, shown in Table 6. Integration issues were grouped in several major categories. Participants frequently referred to two or more areas of contact when describing an integration issue. To analyze the data, responses were first grouped based on the platform mentioned, and then based on the frequency of identified integration issues.

Table 6 shows a weighted sum score, applying different weights to the five ranks to give an overall score representing the participants' opinions. Also shown are the frequency and average ranking for each integration issue. This survey was completed by all 15 participants.

Table 6. CB PPE Integration Issues – Survey Results

	Frequency	Avg Rank ¹	Weighted Sum ²
<u>Helmet</u> •Helmet to APR Fit •Helmet to APR to Suit Fit •Helmet to Communications Fit •Helmet to SCBA Fit	19	4.05	77
<u>Suit</u> •Suit Design •Suit Fit •Suit Fit to Tactical OPS Gear •Suit Joints •Suit to SCBA Fit	16	2.94	47
Body Armor Integration	5	3.60	18
Lack of LE Standards	6	2.83	17
Durability	4	3.00	12
<u>Mask</u> •Mask to SCBA Fit •Mask to Weapons Fit •Mask: Vision Restriction	4	2.50	10
<u>SCBA</u> •SCBA / PAPR/ APR Fit •SCBA to Communications Fit	3	3.00	9
Training	2	4.00	8
PPE System Compatibility	2	3.00	6
Appearance-Threatening	1	3.00	3
Decontamination of Weapons	1	2.00	2
Environmental	1	1.00	1

¹Participants prioritized needs by ranking them from 1 to 5 (1= Greatest Integration Issue)

²Weighted sum is determined by applying weight to each rank and computing the sum. Weights: 1st=5 pts, 2nd=4 pts, 3rd= 3 pts, 4th=2 pts, 5th=1 pt. Greater weighted sum indicates higher group ranking.

The greatest integration issues focused on the helmet and suit, with 19 and 16 occurrences, respectively. The helmet was clearly distinguished as the most pressing integration issue, with a weighted sum of 77. Body armor integration issues and the lack of law enforcement-specific standards also represented important issues to the group, with weighted sums of 18 and 17, respectively. Appendix K has a more detailed summary of these integration issues.

2.3.4 Law Enforcement Specific Mission Role Durations

Objective: Estimate a possible range for the expected length of time a LE officer would need to be protected from a CB threat during the mission roles of Perimeter Control, Tactical Operations and Crime Scene Investigations (CSI)

Focus group participants were asked to consider how long officers might be required to wear their CB ensemble in their perimeter control, tactical operations and CSI mission roles. They were told that their time estimates should represent how long their CB protective gear would need to remain effective. Responses varied based on each participant's interpretation of a mission role type. The question also stated that the CB protective equipment used by officers for each profile may be standardized across their department, so it would need to perform for the longest time required by any wearer assigned to any of the three mission roles. (See Table 7)

While perimeter control and tactical operations missions will always be performed by sworn law enforcement personnel, CSI functions may be performed by highly trained civilian technical personnel. This distinction, while subtle, can impact the length of time it takes to perform CSI, and thereby decreases the time the CB ensemble is required to protect the user. Civilian technical personnel may have shorter CB mission role durations with greater task accomplishment and efficiency, since they have one occupational role and greater task repetition.

Participants felt it was important to be conservative when estimating duration time. They based this on the fact that CB protective capabilities are agent dependant, and affected by temperature, humidity and CB concentration levels. Some participants said to be safe, they typically assume that CB protective equipment will only be effective for half as long as is specified. Agency size also impacts mission role duration. Smaller agencies with limited personnel resources cannot rotate personnel as frequently as larger departments with access to additional manpower.

There was clear agreement among participants that physical environment, prevailing climate, geographical considerations and equipment storage heavily influenced estimated CB mission role durations. (NOTE: This discussion took place in Scottsdale, AZ on a day when the outside temperature was 106°F.)

Table 7. Expected Mission Role Durations

Mission Role	Low-High Responses	Group Average Duration for CB Protection
Perimeter Control	4 hrs-24 hrs	4 hours
Tactical Operations	20 mins-8 hrs	2 – 4 hours
Crime Scene Investigation (CSI)	45 mins-4 hrs	1 – 3 hours

The group concurred that four hours was the average task duration for the perimeter control mission role when performed in a CB environment. Some participants noted that 12-24 hours, or 10 hours with overtime, were possible upper limit perimeter control durations, subject to available resources and environmental conditions.

A group consensus emerged that 2-4 hours is a realistic timeframe for tactical operations. They said that officers in this mission role “get in and out” as fast as possible. They emphasized that greater physical exertion makes heat stress factors and personal hydration more critical in this mission role. The tactical operations role while wearing CB protection requires transport, use of weapons and specialized law enforcement equipment unique to this mission. Tactical operations pose the highest risk to CB protection being compromised by equipment hazards. (Note: One participant reported that while walking forward during a live fire exercise, he stepped on a hot expended firearms shell casing that was in an upright position. The hot casing melted/punctured the sole of his CB protective boot.)

According to the group, the CSI mission duration varies greatly based on the level of ensemble worn (Level A, B, or C), the environment and seasonal variations, and the experience level of the crime scene technician. Airborne threats or contaminants, requiring supplied air, also influence mission duration. (However, one participant noted that with the use of line supplied air, continuous air may be provided up to 100 yards).

2.3.5 Perceived Threats - Chemical / Biological

Objective: Identify threats to law enforcement personnel within the chemical/biological arena.

Participants were asked to identify specific perceived threats in the chemical biological environment. The discussion focused predominantly on the following threats:

- Industrial chemicals – Chlorine gas is a prevalent threat (One participant noted that armed police escorts are now provided for movement of one ton chlorine canisters within a large mid-western urban area.)
- Biologicals – Blood borne pathogens
- Radiological
- Electrical
- Chemical – Riot control agents
- CB ensemble itself is a threat:
 - Physiological – heat stress / exhaustion
 - Self contained Breathing Apparatus (SCBA) low air warning alarm cuts out communications
 - Reduced situational awareness
 - Creates noise – compromises stealth

The group was then presented with a list of known threats developed at NSRDEC, based on common equipment design considerations. These threats are as follows:

- Chemical Vapor Protection
- Biological Aerosol Protection
- Liquid Chemical Weapon Agent (CWA) Resistance
- Flame and Thermal Resistance
- Liquid Integrity
- Blood Borne Pathogen Protection
- Heat Stress
- Ergonomics
- Abrasion Resistance
- Burst Strength
- Cold Temperature Performance
- Tearing Resistance
- Cut Resistance
- Puncture Resistance
- Wear and Weathering
- Anti-Static

The group agreed that equipment performance failures represent threats as significant as any of those created by outside forces.

2.3.6 Wear and Weathering Considerations

Objective: Identify conditions, factors and activities that contribute to CB equipment degradation.

Participants were asked to identify conditions, factors and activities that they felt contributed to chemical biological equipment degradation.

Storage: Shelf Life – Creasing and folding CB suits causes line and point areas of garment stress. One participant noted that manufacturers recommend rolling CB garments rather than folding them for storage to reduce creasing, yet the same manufacturer ships them to the user tightly folded.

Storage: Heat – Sometimes when a garment is stored in a vehicle trunk, under extreme temperatures, its seams can separate even if the garment is still in its original packaging. This occurs with both sewn and adhesive garment seams. CB garments have been removed from storage in a police vehicle trunk in the southwestern US as melted balls of plastic. External heat (non-climate) near a source of exhaust can melt CB suits. APRs stored in vehicle trunks are often rendered useless due to extreme temperatures.

User Maintenance – User maintenance, or lack thereof, greatly impacts equipment functionality. Over time, body fluids and sweating degrade rubber seals on masks and suits.

Law enforcement personnel who fail to perform recommended maintenance, such as replacing rings and seals on SCBA tanks, masks, etc. may compromise equipment readiness.

Design – Independent design of CB component parts contributes to equipment conflicts. Participants noted the following examples of wear and weathering considerations:

- When component pieces are independently manufactured, wear and tear on equipment seams occurs when donning and doffing the equipment.
- On a Level B suit, forcing a Size 12 boot through a leg opening that only accommodates a Size 9 stresses the stitches in the lower leg opening. If the wearer moves up a suit size to solve the leg opening issue, the rest of the suit is too large.
- Universal CB boot sizing fits no one, creates blister points on the wearers' feet, and causes material stress points in the wrong places in the boot. The last point is of particular concern when ascending or descending stairways.

2.3.7 Ergonomic Testing Scenario Review

Objective: Review proposed scenarios for ergonomic testing, specific to the three mission roles of Perimeter Control, Tactical Operations and Crime Scene Investigations (CSI). Validate applicability as well as flow and order of tasks within mission roles, and offer changes or additions.

Proposed ergonomic testing scenarios were presented for perimeter control, tactical operations and CSI mission roles. These scenarios incorporate proposed ergonomic testing methods into real world situations that represent a law enforcement response to a CB incident. Participants were asked if these scenarios accurately represented the types of activities and tasks officers could reasonably anticipate in each situation, and whether they felt that the scenarios would fully reflect the officer's response in each mission role.

Participants felt all ergonomic scenarios must include the full scope of an officer's involvement in that mission role. The scenario begins when they arrive on the scene to don equipment, and ends when they decontaminate and doff equipment. Participants agreed on the task flow/order, with some suggested additions, to represent each mission role. They also stressed the importance of testing the ability to communicate effectively with others in person and via the radio. This requires that all parties wearing the ensemble can hear and be understood.

Perimeter Control

Table 8 outlines steps in the ergonomic assessment plan for the perimeter control mission role. Comments and additional steps recommended by participants are listed in the right column.

Table 8. Proposed Ergonomic Scenario for Perimeter Control

Step	Original Scenario Task	Participant Additions / Comments
1	Don PPE	Reasonable Task <ul style="list-style-type: none"> • Cannot be done unassisted
2	From starting mark, run 50 ft to controlled area.	Unreasonable Task <ul style="list-style-type: none"> • Running cannot be done in PPE. Risk of injury negates any value of speed. • Cannot run in CB PPE “clown shoes.” • Loss of visual acuity and spatial perception necessitates slower movements.
3	Secure caution tape around one item (doorknob, stake, etc) and roll out at least 10 ft of tape before securing the other end. Tape should be approximately 4 feet off the ground.	Reasonable Task
4	Run back 50 feet to starting mark.	Unreasonable Task <ul style="list-style-type: none"> • “Run” not accurate terminology. (See comments in #2) • Suggest use of “move quickly” rather than run.
5	Use radio to call command post. Write down instructions received via radio from command post.	Reasonable Task. <ul style="list-style-type: none"> • Will/can anyone hear you through a mask? Radio interferes with, and cuts out voice amplifier in mask (audio feedback). • Radio frequency shuts down-SCBA voicemitter and radio transmissions are incompatible.
6	Retrieve notebook and pen. Draw rough sketch/map of scene.	Reasonable Task <ul style="list-style-type: none"> • Where are these items retrieved from? • Where is it stored on your PPE? • Is it accessible? • Not doable with certain gloves. • Suggestions of 8x10 paper and crayon or marker to draw on hood of cruiser or command vehicle to create sketch.
8	Duck under tape and walk 20 ft beyond to ‘victim.’ Two-way communications with victim.	Reasonable Task
9	Grab victim under arms and remove from cordoned-off area.	Reasonable Task. <ul style="list-style-type: none"> • Always have two officers for extraction. • May tear suit while pulling victim-drag on material. • Kneeling/squatting may challenge seams. • Holding victim increased weight bearing on CB garment seams.

Table 8. (Cont'd)

Step	Original Scenario Task	Participant Additions / Comments
		<ul style="list-style-type: none"> • Moving in boots (see fit issue task #2) is complicated by additional weight of victim. • Dislodging of CB mask common with unpredictable movement(s) of victim.
10	Render first aid by wrapping upper arm with bandage	Reasonable Task. <ul style="list-style-type: none"> • Cannot be done in Level A or B; decreased tactility is the issue. • Decrease in dexterity.
11	Repair any damage to the caution tape	Reasonable Task <ul style="list-style-type: none"> • Reduced dexterity; difficult to repair caution tape by tying while wearing CB gloves.
12	Walk back to starting area	Reasonable Task
13	Take out flashlight, turn it on and pan across area beyond caution tape – stow flashlight	Reasonable Task
14	Draw weapon from holster, present weapon with two hands for 10 seconds, then re-holster weapon	Reasonable Task
15	Run approximately 10 feet to the other end of caution tape	Unreasonable Task <ul style="list-style-type: none"> • “Run” not accurate terminology (See comments in #2). • Suggest use of “move quickly” rather than run.
16	Re-draw weapon, aim, speak commands, and simulate firing two shots	Reasonable Task <ul style="list-style-type: none"> • Large fingers on butyl gloves interfere with placing finger into trigger well. • Suggested placing latex gloves over butyl gloves to reduce circumference of fingers allowing smoother finger entry into trigger well. • Communications a problem without voice box.
17	Eject and replace magazine, Re-holster weapon	Reasonable Task <ul style="list-style-type: none"> • Is this a tactical or emergency re-load? Different actions are required for each.

Several participants expressed concern over communications issues in the CB attired perimeter control ergonomics discussion. Ergonomics of perimeter control require several different kinds and levels of communication.

Denial of entry or evacuation route communications;

- You may need to communicate information to persons who are 15-20 feet away;
- Even with a voicemitter for voice amplification, you can't speak loudly enough to give directions to a crowd;
- The tendency to shout while wearing a CB mask causes voice distortion;
- Use of an external PA/Bullhorn is believed possible with a mask on, but none of the participants had tried it on a civilian crowd. Crowds at a perimeter might be agitated,

not only by circumstances requiring the donning of CB attire, but also by the unusual appearance of law enforcement personnel now trying to give them voice commands at a perimeter.

Participants believed that two tasks should be added to the perimeter control ergonomics assessment. These tasks assume the user is wearing a CB ensemble while establishing and controlling a perimeter. The two tasks are detailed below, accompanied by participant questions and concerns relative to those tasks.

Setting up flares:

- Can a flare be properly unwrapped, ignited and manipulated?
- What is the spark radius of a hand-held flare?
- Would sparks from a flare burn through the ensemble?

(Note: Participants noted that there was no prior experience in deploying flares while wearing CB ensembles, even in training exercises, but this is a reasonable task to anticipate during an event.)

Operating a motor vehicle:

- Reduced visibility;
- Reduced auditory sensitivity;
- Reduced range of motion;
- Vehicle operator area – size restrictions if wearing SCBA;
- Closing door on CB suit;
- Snag/puncture issues – seat belt, sharp edges inside vehicle;
- Manipulation of levers – ignition key, gas, brake, shift, lights;
- Opening of trunk to retrieve additional equipment; and
- Creation of static charge sliding across seats.

Tactical Operations

Table 9 outlines steps in the ergonomic assessment plan for the tactical mission role. Ergonomic assessment instructions indicated that tactical operations tasks were performed in teams of 6-8 law enforcement officers. Comments and additional steps recommended by the participants are listed in the right column.

Table 9. Proposed Ergonomic Scenario for Tactical Operations

Step	Original Scenario Task	Participant Additions / Comments
1	Don PPE	Reasonable Task <ul style="list-style-type: none"> Is body armor inside or outside the CB garment? Body armor, wherever worn, increases friction on CB garment. No place to hang tactical equipment outside CB garment.
2	Scale 6 foot wall	Reasonable Task <ul style="list-style-type: none"> Need two ladders (up and down). Task causes abrasion and stretching if wall is masonry – puncture /slash risks if iron/wood. If using ladders, then issues of snag/cuts from ladder carry and use.
3.	Walk along wall for 20 feet to a closed door	Reasonable Task <ul style="list-style-type: none"> Potential abrasion / friction issues
4.	Utilize covert signals prior to entry	Reasonable Task <ul style="list-style-type: none"> Covert signals cause virtual issues: <ul style="list-style-type: none"> Visibility of hand signals is poor wearing butyl gloves. Hand signals hard to make and see. Fine motor skills are compromised.
5.	Breach door using a ram	Reasonable Task <ul style="list-style-type: none"> Reduced range of motion for ram swing. Steel rams have abrasion and cutting surfaces. Violence of breaching sets metal/glass flying: added risks of slash/puncture.
6.	Enter into doorway with weapon drawn, aim and simulate firing	Reasonable Task <ul style="list-style-type: none"> Firing what? Specify sidearm or shoulder weapon? This task should be between #2 and #3. All movements from that point on are made with weapon drawn If shoulder weapon, then cheek weld is lost while wearing CB mask
7.	Transition to secondary weapons system	Reasonable Task. <ul style="list-style-type: none"> Snags issue from shoulder weapon sling system on suit. If shoulder weapon is fired, then slung-hot barrel contact could melt CB ensemble.
8.	Enter area	Reasonable Task <ul style="list-style-type: none"> Entry through a breached portal poses cut/snag risk from remaining debris on portal edges or floor. Reduced visibility increases cut/puncture risks.
9.	Speak verbal commands to a suspect lying on the floor 10' inside, while keeping a weapon trained on dummy	Reasonable Task <ul style="list-style-type: none"> Verbal commands are difficult. Voice modulation required for clarity. Must use simple commands.
10.	A second officer approaches suspect. Holster weapon and use handcuffs to restrain the suspect's arms	Reasonable Task <ul style="list-style-type: none"> Use flex cuffs instead of handcuffs. Metal cuff saw-toothed edges risky. Flex cuffs difficult to manipulate due to loss of dexterity. If flex cuffs are pre-looped, then where are the flex cuffs carried?

Table 9. (Cont'd)

Step	Original Scenario Task	Participant Additions / Comments
		They become a big snag hazard outside of CB ensemble.
11.	Frisk suspect to ensure not armed	Reasonable Task <ul style="list-style-type: none"> Compromised tactility wearing gloves. Close proximity creates increased risk Puncture risk from needles and sharp objects potentially possessed by suspect. Kneeling stresses joints on CB ensemble.
12.	Provide radio confirmation of suspect in custody	Reasonable Task <ul style="list-style-type: none"> Dexterity a challenge in activating radio transmit button.
13.	Escort individual out of building	Reasonable Task <ul style="list-style-type: none"> Grip strength compromised somewhat with CB gloves Snag hazard(s) increase based on the escorted individual's compliance. Moisture further compromises grip.
14.	Continue clearing ground floor rooms	Reasonable Task <ul style="list-style-type: none"> Do you have to decontaminate suspect in previous item?
15.	Descend stairs to low light area	Reasonable Task <ul style="list-style-type: none"> Presents abrasion and trip hazards due to boot sizing. Lighting in heads up display compromises transition to low light area. Ascending/descending stairs wearing SCBA changes officer's center of gravity.
16.	Officers locate injured victim and escort/ remove from building	Reasonable Task <ul style="list-style-type: none"> Change escort/remove to "carry" or are they being guided out? Weight of person and angle of ascent stresses CB, especially boots.
17.	Team exits building	Reasonable Task <ul style="list-style-type: none"> Amend to include "and proceeds to decontamination" to reinforce the concept that all of the above tasks were performed in a CB environment.

Participants believed that two tasks should be added to the tactical operations ergonomics assessment. These tasks assume the user is wearing a CB ensemble while performing tactical operations. The two tasks are detailed below, accompanied by participant questions and concerns relative to those tasks.

Use of knee pads and kneeling – Kneeling and associated movements should be considered throughout the scenario in tactical operations. Kneeling was only peripherally suggested during the tactical operation's suspect frisking task.

Add "officer down" associated task – Injury of an officer greatly increases psychological and physiological pressure, and is a likely event in any tactical operation.

Crime Scene Investigation (CSI)

Table 10 outlines steps in the ergonomic assessment plan for the CSI mission role. Ergonomic assessment instructions indicated that the CSI tasks were performed in a team of two persons (“Clean” vs. “Dirty”). Comments and additional steps recommended by the participants are listed in the right column.

Table 10. Proposed Ergonomic Scenario for CSI

Step	Original Scenario Task	Participant Additions / Comments
1.	Don PPE	Reasonable Task
2.	Walk 50 feet to crime scene down a narrow hallway, pulling or pushing evidence collection kit	Reasonable Task <ul style="list-style-type: none"> Typically we’re pulling gardening wagons
3.	Retrieve cameras (video and digital) and document crime scene	Reasonable Task <ul style="list-style-type: none"> We use auto focus cameras because CB ensemble prevents holding camera to face for proper focal distance. We put cameras in dive boxes- they have bigger buttons for increased dexterity and can be decontaminated, thereby saving camera.
4.	Approach a table with a two inch square marked off at the far side of the table	Reasonable Task
5.	Collector uses fingerprint kit to powder, dusts and tapes the print. Remove the tape and secure the print on tape	Reasonable Task <ul style="list-style-type: none"> Change to “Secure print on lifter”
6.	Collector photographs print, secures in plastic bag and hands to receiver	Reasonable Task <ul style="list-style-type: none"> Photograph BEFORE lifting: move this task up in sequence.
7.	Remove outer glove	Reasonable Task <ul style="list-style-type: none"> Prevent cross contamination Remove glove with forceps
8.	Move 4 feet to the side and locate a small item (e.g. pin) on the floor. Place ruler next to and photograph item. Squat and pick up item with tweezers. Secure item in plastic bag. Hand to receiver.	Reasonable Task
9.	Remove outer glove.	Reasonable Task (See # 7)
10.	Receiver calls command on radio with update on evidence collected.	Reasonable Task
11.	Continue on to the next item. Measure, photograph, inventory and secure all remaining items. Remove gloves between each collection.	Reasonable Task
12.	Collect an air sample using air monitoring device.	Reasonable Task <ul style="list-style-type: none"> Out of sequence flow - air collection task should begin upon entry at task #2
13.	Stand, secure all items collected or used, move 6 feet backward then turn around and walk to starting point.	Reasonable Task

Participants believed one task should be added to the crime scene ergonomics assessment. This task assumes the user is wearing a CB ensemble while conducting CSI in a CB environment. The task is detailed below, accompanied by participant comments relative to that task.

Evidence decontamination task – Evidentiary materials are collected, bagged and bagged again so the outer bag can be decontaminated without compromising the integrity of the evidence in its original collection bag.

3.0 Conclusions

Two thirds (67%) of participants had 15 or more years of law enforcement experience. Job duties involved office work, day-to-day operations, and tactical and specialized functions, but most participants had tactical expertise (63%). Some participants said they respond to and train for CB incidents often, while for others CB occurrences and training are less frequent. (Several survey questions addressed the individual's experience, job duties, PPE usage, and duty uniform wear. Appendix B has a complete summary of the participants' information survey results.)

An overarching theme emerged from this LEAP User focus group relevant to all topic areas: participants were concerned about the lack of a national set of standards for equipment requirements specific to the law enforcement community. In the survey and the discussions, they felt that the standards created for the fire community do not adequately address the unique needs of law enforcement mission roles: perimeter control, tactical operations and CSI. Participants cited examples and reasons why not having a national set of standards limit their effectiveness and causes operational inefficiencies. To ensure that standards are met, participants felt that the organization, or body that establishes any national set of standards, would need to work cooperatively with various law enforcement stakeholder organizations.

Duty Uniform

The law enforcement duty uniform will always represent the most identifiable symbol of its personnel. Participants expressed their desire for duty uniform standards. They described several features that a new uniform should incorporate such as: increased cut/slash/stab protection, and minimal levels of protection against chemical, biological, and blood borne pathogen threats to protect officers who must respond to incidents without knowledge of these dangers or any form of protection against them. They stated that officers and departments are deeply concerned with uniform appearance. Comfort and functionality are also critical issues.

They mentioned several factors important to the officer community that could be potential challenges in adopting a new standard. Factors include maintaining tradition and unique department identities, and projecting an image of authority without appearing overly intimidating or militaristic. They noted that attitudes in the LE community are shifting toward more functional designs for duty uniforms.

The user questionnaire asked respondents if there was a need for improved duty uniforms; 87% responded "Yes." (Two skipped the question). Further description of what the significant needs were included incorporating some level of protection against CB threats, ballistics, flame, biological, blood borne, and other liquids. Participants noted a new duty uniform should have good durability, functionality, and comfort among several other factors. All responded that a duty uniform standard is needed.

Half of the group said that the source of funding would affect their purchase of a uniform. Most said that they replace their duty uniforms fewer than once a year, and that their uniforms are paid for by departmental funding. The group identified abrasion and fading as the most common durability problems. On average, duty uniform durability was rated as being “Slightly” to “Moderately Good.” In contrast, on the questionnaire, 60% of participants responded that durability issues are common problems for CB garments.

Integration Issues: Head Protection

During the PPE integration discussion, participants described several typical integration problems they experience with their equipment. Most integration issues discussed involved restricted equipment access due to obstruction or concealment by other gear. Radio access is particularly problematic. Integrating protective head gear with breathing apparatus and communications equipment is a high level concern.

Participants also said that there are problems wearing plate armor with a CB ensemble due to bulk and restrictiveness. Further, when participants wear respirator masks, they have trouble giving non-radio voice commands and difficulties sighting a shoulder fired weapon. Suspension and security of head protection platforms are integral factors influencing integration with other protective equipment components. In addition, interagency equipment incompatibilities exist, which participants believe can be resolved by standardization.

Physical sustainability of officers in CB ensembles ranked highest throughout the focus group discussions. Helmet fit was the biggest issue on the short survey for CB Protection Integration issues. Head protection integration with CB ensemble fit was the second highest priority issue. Additional head protection integration issues included the problematic interface between head protection and body armor.

Chemical/Biological Protection

In the CB protection segment, participants discussed the proposed mission roles, relevant activities for law enforcement and related integration issues. They felt that physical sustainability of equipment wearers, communication, mobility, donning/doffing and weapons integration issues greatly impacted their ability to perform effectively and for extended time periods in a CB environment. Facilitated discussions took place in Scottsdale where the outside temperature was 106° F. This environment highlighted group concerns for heat stress and respiratory sustainability while wearing CB protective equipment, as safety issues are a major limiting factor in officers’ abilities to perform their duties.

Participants debated the exact nature of the roles officers would have during a CB incident. They did not agree on the distinction between first responder/reporter and perimeter control mission roles in the discussions and the surveys. Most participants felt that perimeter control and CSI would last approximately one shift and tactical duties would require slightly less time. They also disagreed regarding the role of law enforcement in HAZMAT operations; some participants felt this was the responsibility of fire services.

Participants were presented with potential scenarios in the three mission roles and asked to evaluate human factor issues resulting from wearing CB protective equipment. They were asked whether the steps described accurately represented the scope of tasks officers would perform in each scenario, and to include any additional steps they felt were appropriate for testing and remove any which were not appropriate. In all three scenarios, participants added steps to incorporate donning and doffing equipment, and to test the ability to communicate effectively verbally, via radio and through gestures.

Participants rated the average durability of their CB ensembles as “Slightly Good,” with tearing and abrasion identified as the most common issues they experience. (See Appendix B, question 19 for more information related to protective garments currently used by the participants.)

Overarching Concern

The overarching concern in all topic areas was the question of how practitioners can move forward with any consistency if law enforcement does not have its own specific set of standards. Standards provide guidelines for practitioners when making purchasing decisions, and give manufacturers a set of requirements to supply equipment that meets the needs clearly described throughout this report. Standards development and implementation specific to LE will provide a much-needed level of practitioner interoperability, will support a common approach that goes beyond a specific locality or region and will enable nation-wide consistency in operations and response.

This document reports research undertaken at the U.S. Army Natick Soldier Research, Development and Engineering Center, Natick, MA, and has been assigned No. NATICK/TR-08-1010 in a series of reports approved for publication.

Appendix A – User Workshop Participant Survey

Name _____

Please take your time in completing this survey. Your input is very valuable and appreciated. Please answer each question carefully by writing legibly or filling in the appropriate bubble. If you have any questions, please ask. Thank you for your time in completing this survey.

Section I: Demographics

1. What is your gender?

☐ Male ☐ Female

2. What is your job title? _____

3. What is your current rank? _____

4. Which type of agency do you work for?

☐ State

☐ Local

☐ Federal

5. Where is your agency located? (City, State) _____

6. How many years of law enforcement experience do you have?

☐ < 1 Year

☐ 1-5 Years

☐ 6-10 Years

☐ 11-15 Years

☐ > 15 Years

7. What is your primary job function?

☐ Day to Day Field Operations

☐ Office / Headquarters

☐ Tactical / Specialized

☐ Other ~ _____

Section II: Chemical/Biological Protection

8. What type of respiratory protection do you currently utilize? Please specify manufacturer and model.

- ☐ Self Contained Breathing Apparatus (SCBA), Please Specify _____
- ☐ Air Purifying Respirator (APR), Please Specify _____
- ☐ Powered Air-Purifying Respirator (PAPR), Please Specify _____
- ☐ Escape Respirator, Please Specify _____
- ☐ Hybrid/Combined Respiratory System, Please Specify _____

9. Please provide product information on the CB garment/suit you typically utilize.

Manufacturer	Model

10. Do you feel there is a common durability issue(s) related to CB garments?

- ☐ Yes ☐ No

Please describe the durability issue(s): _____

11. What contributes to the cause of the durability issue(s)? (i.e. material, construction, design, etc.)

Please explain: _____

Section III: Duty Uniform

12. Do you feel there is a need for improved duty uniforms?

- ☐ Yes ☐ No

Please explain: _____

13. What type of duty uniforms do you currently have? (Fill in all that apply)

- ☐ Class A Uniforms
- ☐ Class B Tactical Uniforms
- ☐ Class C Uniforms
- ☐ BDU's
- ☐ Shirt/Polo
- ☐ Other ☐ _____
- ☐ Other ☐ _____

14. Please provide product information on the duty uniforms you typically wear.
List any shirts (short and long sleeve), trousers, and/or shorts (if applicable).

Type (i.e.: Class A, etc)	Garment (Shirt, Trousers, etc)	Manufacturer	Model

15. How often do you have to replace your current duty uniform?

- ☐ Once a month
- ☐ Approximately 4 times a year
- ☐ Less than once a year
- ☐ Never

16. Do you feel there is a common durability issue(s) related to Duty Uniforms?

☐ Yes ☐ No

Please describe the durability issue(s): _____

17. What contributes to the cause of the durability issue(s)? (i.e. material, construction, design, etc.)

Please explain: _____

Section IV: Head Protection

18. Do you typically wear a ballistic helmet as part of your job?
(protection against small arms, projectiles, and fragments)


☐ Yes ☐ No

19. Do you typically wear an impact protective helmet as part of your job?
(protection against falls and impacts with obstacles)

☐ Yes ☐ No

Please only answer the remaining questions if you DO wear a helmet as part of your job.

20. Do you currently have or use any of the following accessories with your protective headgear?
(Mark all that apply)

Component	Manufacturer	Model
<input type="checkbox"/> Camera		
<input type="checkbox"/> Illuminator (flashlight)		
<input type="checkbox"/> Infra-red illuminator		
<input type="checkbox"/> Night vision equipment		
<input type="checkbox"/> Communications		
<input type="checkbox"/> Eye protection		
<input type="checkbox"/> Hearing Protection		
<input type="checkbox"/> Gas / CB protective mask		
<input type="checkbox"/> CPR mask		
<input type="checkbox"/> None		
<input type="checkbox"/> Other  _____		

21. Do you experience any problems with headgear accessories being incompatible with each other or your helmet?

☐ Yes ☐ No

If yes, which accessories:

When does this occur?

Appendix B – Participant Information Survey Results

The following tables summarize responses on the participant background questionnaire. The term “frequency” is the number of times a particular answer was given. Percentages are shown. In cases where participants did not answer a question, percentages are based only on the number of participants who responded. When a participant’s desired response was not available to choose from, they were encouraged to provide a response in a write-in area for that question. These responses are listed verbatim in supplemental tables for each question, if necessary.

Of the fifteen participants of the focus group, one member was female and the rest were male. Eighty percent of the group was from local law enforcement, with two participants representing state agencies and one from a “federal and local” agency. Years of experience varied, but 67% of the group said they have more than 15 years of experience in law enforcement. All participants had over six years of experience.

Section I: Demographics

1. *What is your gender?*

	Frequency	Percent
Female	1	6.7%
Male	14	93.3%
Total	15	100.0%

2. *What is your job title?*

The responses were as follows:

- Watch Commander
- Lieutenant/SWAT Commander
- Police Officer
- Bike Patrol Officer
- Trooper
- Detective
- Special Assignments Unit -Operator
- Police Officer
- Deputy Sheriff
- ATF Task Force/Hazardous Devices Unit
- Sergeant/Patrol/SWAT
- Criminalist
- Sergeant/Tech Services/Comprehensive Information Systems Project
- Director of Emergency Management
- SWAT Sergeant

3. *What is your current rank?*

The responses were as follows:

Detective	1
Lieutenant	3
N/A	1
Officer	1
POII	1
POIII	1
Senior Patrolman	2
Sergeant	4
Trooper	1
Total	15

4. *Which type of agency do you work for?*

	Frequency	Percent
Local	12	80.0%
State	2	13.3%
Local/Federal	1	6.7%
Total	15	100.0%

5. *Where is your agency located?*

The responses were as follows:

Albuquerque	NM	1
Ankeny	IA	1
Ann Arbor	MI	1
Arlington	TX	1
Charlotte	NC	1
Chicago	IL	1
El Paso	TX	1
Helena	MT	1

Las Vegas	NV	1
Lexington	KY	1
Los Angeles	CA	2
Phoenix	AZ	1
St. Louis	MO	1
Boston	MA	1
		15

6. *How many years of law enforcement experience do you have?*

	Frequency	Percent
6-10	3	20.0%
11-15	2	13.3%
>15	10	66.7%
Total	15	100.0%

7. *What is your primary job function?*

	Frequency	Percent
Day to Day Field Ops	3	18.8%
Office/Headquarters	1	6.3%
Other	2	12.5%
Tactical/Specialized	10	62.5%
Total	16	100.0%

Note: the responses add up to more than 15, as one respondent selected both Day to Day and Tactical/Specialized, indicating the two job functions he has.

The group primarily represented tactical/specialized job functions, with 62.5% tasked with these duties. The “others” listed were:

- WMD Trainer;
 - Counterterrorism;
 - Crime Scene/Latent Print Examination; and
 - (Preparedness, Response, Recovery and Mitigation) Coordination of Planning, and Training of All Emergency Response Resources in the City of Ann Arbor;
- In addition, management of all DHS Grants

Section II: Chemical/Biological Protection

Participants described the CB garments that they typically wear.

8. *What type of respiratory protection do you currently utilize? Please specify manufacturer and model.*

Self Contained Breathing Apparatus (SCBA), Please Specify

The responses were as follows:

Bomb Squad/Narcotics
Draeger
Interspiro
Panther
Scott
Scott and MSA
Scott Airpack
Scott Swat Pac
SWAT Team Only: Scott SWATT Pak 45 min. tank w/AV3000 Cylinder Facepiece

Air Purifying Respirator (APR), Please Specify

The responses were as follows:

3M FR-M40B
All Personnel: M98 Gas Mask 40 mm canister (Scott) P/N 045123
Avon FM12
MSA
MSA Advantage 1000
MSA Millenium
MSA Millenium, Ultra Elite
P/N 045123
Scott M95/Avon Emiz, Avon C50

Powered Air-Purifying Respirator (PAPR), Please Specify

The responses were as follows:

3M PAPR
MSA
SCOTT M95
SWAT Only: Scott ProFlow 2SC connecting to AV3000 Facepiece

Escape Respirator, Please Specify

The responses were as follows:

N/A

Hybrid/Combined Respiratory System, Please Specify

The responses were as follows:

Drager BG-4
Patriot System

9. Please provide product information on the CB garment/suit you typically utilize.

CB garments used by participants:

CB Manufacturer	CB Model	Frequency
(All Personnel) Kappler	Tychem Tape (1 roll per officer)	1
(All Personnel) North Safety Products	-North BLK Chemical Resistance Boots -North Silver Shield Gloves (CE 0120) -North Super Nova Butyl - STD Gloves (Blk)	1
(All Personnel) Tychem F Coverall	TF 16ST: Gray in color; front zipper closure attached respirator fit hood w/elastic around face, attached boots, and elastic wrists.	1
(SWAT Only) LANX Fabric Systems	Dark Blue Lanx Type 1 Fabric; Chem Protective, Fire/Flame Resistance	1
(Swat Only) Tychem F Coverall	TF169T; Army Green in color, same as above in all other areas. Color was for SWAT, Green is not as visible as Bright Gray	1
3M	CPF3	2
DuPont	TyChem 10000	1
Goetzloff	Eurolite NBC	1
Kappler		1
Lakeland	Tychem TK	1
Lakeland	Tyvek F	1
Lanx Suits	CPO	1
Rampage	Charoal	1
Saratoga	Hammer	1
Saratoga	JSLIST	1
Tex-Shield	Hammer Suit	1
Tyvek		2
Unknown	Chem Suits for Bomb Squad and Narcotics Units	1

10. Do you feel there is a common durability issue(s) related to CB garments?

	Frequency	Percent
N	4	27%
Y	9	60%
Null	2	13%
Total	15	100%

When asked to describe the durability issues, the following responses were provided:

A lot of our officers complain that they tear in the crotch and during activations/incidents while officers bend over.
Continuous exposure to heat tends to break down the suit - usually at the seams.
Depending on the type of exposure, they can only be used once. Regular Cleaning (sweat/dirt) they are only to be washed 10 times.
Have not used it yet; still in package
I haven't experienced this issue.
Integrity Issues, Dry Rot
Not Designed for Law Enforcement
Not Designed for LE Officers
Number of uses after De-con (if possible)
The Tychem F offers effective protection against nerve and other terrorist agents. It is heavier than Tychem SL and more tear-resistant, which is important in our line of work. Although Tychem BR offers the most effective protection, it is too stiff and bulky for our line of work. (Info provided on chem/bio the suit protects one from, and the permeation rates, which also provides for a sense of security
Unsure; haven't used this enough
We utilize the suits in extreme heat environments that reduce lifetime usage.

11. *What contributes to the cause of the durability issue(s)? (i.e. material, construction, design, etc.) Please explain:*

The responses were as follows:

Usage in Training, Material, Improper Cleaning after Usage, Universal Sizing
DeCon Applications
Construction Not Reinforced
I believe the material both outer and inner (charcoal) has a limited lifetime. This includes a mission/exposure and normal wear and tear.
Material is the largest factor.
Suits are issued to our SWAT officers - they are carried in their cars and exposed to 150 degrees + for extended time periods.
Design and construction of suit, seams, protection of knees and elbows, etc.
unknown
This is a design issue; suits possibly need longer torso construction.
If there are some issues, they are as follows: 1) Equipment remains in a sealed plastic bag until needed, will equipment work when called upon? 2) the suit will limit officers' mobility (need to educate officers that duties will change if suits are a required use). I suppose the main cause is lack of knowledge and the unknown. We issued all the above equipment, trained officers in its use, and distributed the same. A year later 95% of issued equipment is in the storage area at the station - the officers do not use equipment, therefore they complain about carrying it to their vehicle, along with all the other equipment (i.e. AED machine, shotgun, paperwork, ticket books, briefcase and lunch).

Section III: Duty Uniform

12. Do you feel there is a need for improved duty uniforms?

Everyone who responded to the question indicated YES:

	Frequency	Percent
Y	13	87%
Null	2	13%
Total	15	100%

Explanations were as follows:

A need for fewer - but usable - uniform ensembles
Better design for comfort in various weather conditions
Better durability - integrated designs
Better protection against body fluid exposure and day to day wear and tear
Bio and Bloodborne
Comfort and Durability
Current Uniforms (including BDUs) provide little to no emergency/immediate protection from CBRN attack
Flame Resistance as a minimum
Functionality over tradition is needed
The Duty Uniform (Class A) is actually our first line of protection. The majority of uniforms soak up liquid as opposed to being resistant to liquid (sort of like the water resistance Dockers). I think we could really improve the duty uniforms to make them more comfortable and resistance to same liquids, etc
They can be improved for durability, but overall fit and function is fine.
We have a good amount of selection for uniform choice depending on job assignment.

13. What type of duty uniforms do you currently have? (fill in all that apply)

	Frequency	Percent
Class A	11	73%
Class B	9	60%
Class C	2	13%
BDUs	12	80%
Shirt/Polo	6	40%
Other	7	47%

14. Please provide product information on the duty uniforms you typically wear.
List any shirts (short and long sleeve), trousers, and/or shorts (if applicable).

The responses were as follows, categorized by uniform type:

Class A	Class B	Class C	BDUs	Shirt/Polo	Other
Shirt (Blauer/Flying Cross)	Trouser (Blauer)				
Shirt (Elbeco Paragon Plus) SHO93; Trousers (Unk. 70% Poly/30% Wool)					
Shirt, Pants (Blauer)					Tactical BDU - Black (ProTech)
Shirt, Trousers (Eagle Tech Inc)	Trousers (Blauer) Model 8810, Model 8818 BDU Shirt (Blauer)		BDU Shirt, BDU Trouser (Military Surplus)		
Shirt/Trousers (Blauer)					Bike Patrol Shirts, Shorts, Zip Out Pants (United/ Olympic Coolmax Zip)
Shirt/Trousers (Blauer, Horace Small, Elbeco, Hercules)			Pants (5.11)		
Shirt/Trousers (Clifton-65%Dacron/ 35% Wool)	Shirt/Trouser (Blauer 8703)		Shirt/Trouser (Cav-Pro 50/50)	Shirt/Pants (5.11 Tactical)	
Shirt/Trousers (multiple manufacturers; LAPD Specs)		Shirt/ Trousers (multiple manufacturers; LAPD Specs)	Shirt/Trousers (multiple manufacturers; LAPD Specs)	Polo Shirt (5.11)	
			Wool Shirt, Wool Trousers - LAPD Specs		
			Shirt, Pants (Propper/Tru-Spec); Woodland/ Black Model		
	Shirt/Trouser				

15. How often do you have to replace your current duty uniform?

	Frequency	Percent
<Once a Year	11	73%
Annually	1	7%
Approximately 2 times a year	1	7%
Approximately 4 times a year	1	7%
Null	1	7%
Total	15	100%

16. Do you feel there is a common durability issue(s) related to Duty Uniforms?

	Frequency	Percent
N	2	13%
Y	10	67%
Null	3	20%
Total	15	100%

Explanations were as follows:

Fading of Class B Uniforms
As our first line of protection from a variety of dangerous fluids (c/b), our current duty uniforms are not effective. (ex: if officers are involved in a fight and exposed to blood, the blood soaks through the uniform with ease).
Class A Uniforms are stiff and have very little flexibility
Cleaning-laundry wears them down
Color Loss
Flame retardant uniforms tend to be either very heavy and hot, or thin and easily torn
Length of Service, Life of Uniforms
Normal Wear and Tear - every day patrol
Small problem areas, stitching, pockets, collars, etc
Wear/Tear of Everyday Use

17. *What contributes to the cause of the durability issue(s)? (i.e. material, construction, design, etc.) Please explain:*

All the listed examples. The material is cheap. The design and construction is not up to date with the many different hazards that face first responders.
Cleaning
Material
Material - company should use a heavier type with better stitching
Material and Design made for image and not durability
Material, Improper Washing
Materials and Design of uniforms
Some construction Designs or Seams

Section IV: Head Protection

18. *Do you typically wear a ballistic helmet as part of your job? (protection against small arms, projectiles, and fragments)*

	Frequency	Percent
N	4	27%
Y ¹	11	73%
Total	15	100%

¹ One participant noted that he wears a Kevlar helmet, but it's not purchased by the department.

19. *Do you typically wear an impact protective helmet as part of your job? (protection against falls and impacts with obstacles)*

	Frequency	Percent
N	9	60%
Y	6	40%
Total	15	100%

Please only answer the remaining questions if you DO wear a helmet as part of your job.

20. Do you currently have or use any of the following accessories with your protective headgear? (Mark all that apply)

Component	Responses	Manufacturers/Models Cited
Camera	0	
Illuminator (flashlight)	2	Streamlight, LED Headlamp
Infra-red illuminator	0	
Night vision equipment	5	Mil-Surplus, Military-issue
Communications	7	Motorola MTS 1000/MTX3000 - PTT Privacy Pak (one ear); LASH threat mic; Eagle Headsets
Eye Protection	9	ESS; Bolle Tactical 3000 Goggles; ProTech Armor 702M Level II Multi; Pull Down Shield (Riot Control)
Head Protection	3	Peltor Tac6
Gas/CB Mask	11	3M; FR-M40B; Scott M95 (2); Scott M98; MSA; MSA Millenium; Scott; Def Tec-Opti 7 it
CPR Mask	0	
None	1	
Other	1	SCBA - Scott Swat Pac

21. Do you experience any problems with headgear accessories being incompatible with each other or your helmet?

	Frequency	Percent
N	3	20%
Y	9	60%
Null	3	20%
Total	15	100%

Of those who indicated that problems were experienced, the accessories noted were:

All of them have their quirks. The Nightvision is most likely to interfere. The headlamp has proven helpful in the past.
APR
APR and SCBA; our NVS is new and untested
Gas masks, radio comms
Peltor Hearing Protection
PPE Gas Mask - SWAT Goggles
Riot Face Shield, Gas Mask
Scott Mask/Goggles

When asked “When does this occur?” responses provided were:

Cheek weld on long guns
Depends on the situation. There needs to be a helmet that is cost effective that addressed the following: Ballistic Helmet which can be easily converted to a riot helmet, that contains a pull down/flip down shield, as well as fit securely while wearing a gas mask.
During Range Training with Gen-Tech Helmet
Most compatibility issues occur with ballistic helmets as impact helmets are set to civilian/fire usage and have been engineered to work with add-ons in many different configurations
Use with tactical helmet; helmet rides down and pushes goggles off
Wearing Helmet and APR
When shifting/moving

Appendix C – Read Ahead Material

Also included in the Read Ahead material was the User Survey, found in Appendix A.

Law Enforcement (LE) Personal Protective Equipment (PPE)

Focus Group: Topic Areas

The LE PPE focus group will consist of four (4) facilitated half-day Focus Group/Panel segments. The purpose of these sessions is to further refine law enforcement needs and performance criteria in multiple PPE technology areas. These areas include Duty Uniforms, Integrated Head Protection (IHP), Chemical Biological (CB) Protection, and Human Systems Integration.

Prior to attending the Law Enforcement PPE Focus Group, we ask that you please review these topic areas. We value your input and thank you for your time.

Duty Uniforms

- Currently utilized materials/systems
- The need for increased protection
- Appearance consideration
- Laundering protocols
- Durability issues
- Comfort characteristics
- Integration concerns

Integrated Head Protection

- Currently utilized add-on components
- Protection Needs
- Required Capabilities
- Integration Considerations

Chemical/Biological (CB) Protection

- Law Enforcement Mission Roles
- Operational Tasks CB Response
- Mission Duration
- Threats
- Wear and Weather Degradation Factors
- Ergonomic Considerations
- Integration Considerations

In addition, we ask that you please review the following information related to Law Enforcement Mission Roles within the response to a CB incident. This will be a topic of discussion and will provide the basis for the majority of the CB Protection focus groups segment.

Law Enforcement Mission Roles

This study focuses on the LE practitioner, which includes Local, State, Tribal and Federal law enforcement departments, DHS LE elements such as U.S. Customs and Border Protection, Secret Service, U.S. Coast Guard, and others. Combined, these practitioners perform a wide range of mission roles in their day-to-day activities. .

The National Domestic Preparedness Office, *On Scene Commander's Guide for Responding to Biological/Chemical Threats*, identifies the primary role of law enforcement responding to a credible threat to include the following:

- Making proper notifications
- Assessing the situation
- Removing people from harm's way
- Establishing a crime scene and scene security
- Stabilizing the incident
- Determining the credibility of the threat
- Searching for additional hazards (being cognizant of secondary devices)
- Initiating the criminal investigation and gathering information
- Securing evidence

In addition, we list assumptions below about volatile situations that occur as a result of these types of major events, which can:

- Occur at any time with little or no warning
- Require significant information-sharing at both unclassified and classified levels across multiple jurisdictions and between public and private sectors
- Involve single or multiple geographic areas
- Impact or require significant international information sharing, resource coordination, and/or assistance
- Span the spectrum of incident management including prevention, preparedness, response, and recovery
- Involve multiple, highly varied hazards or threats
- Result in numerous casualties; fatalities; displaced people; property loss; disruption of normal life support systems, essential public services, and basic infrastructure; and significant damage to the environment
- Impact critical infrastructures across sectors
- Attract an influx of spontaneous volunteers and supplies
- Require short-notice asset coordination and response
- Require prolonged, sustained incident management activities

Five Major Mission Roles

Based on analyzing reports and literature and performing subject matter interviews, law enforcement chemical/biological (CB) response can be defined by five key mission roles: First Responder/Reporter, Perimeter Control, Tactical Operations, Crime Scene investigation (CSI), and Law Enforcement Personnel and Equipment Decontamination.

Each mission role identified operates in one or all of the isolation zones typically used during response to CB or hazards materials incident. These zones are defined as follows:

- Hot Zone – is the area immediately surrounding a dangerous goods incident which extends far enough to prevent adverse effects from released dangerous goods to personnel outside the zone.
- Warm Zone – is the area between the Hot and Cold zones where personnel and equipment decontamination and hot zone support take place. It includes control points for the access corridor and thus assists in reducing the spread of contamination.
- Cold Zone – is the area where the command post and support functions that are necessary to control the incident are located.⁴

Each mission role is summarized below.

1) First Responder/Reporter – This is typically the first LE officer at the scene who discovers the actual incident and reports back to command. This responder/reporter is responsible for implementing response communications plans and protocols in accordance with the NIMS and ICS.



2) Perimeter Control – The perimeter control mission role is responsible for reducing overall “impact and consequences of an incident or major event by securing the affected area, including crime/incident scene preservation issues as appropriate, safely diverting the public from hazards, providing security support to other response operations and properties, and sustaining operations from response through recovery.”⁵ Perimeter control officers typically are charged with containing the situation at the cold/warm and warm/hot zone lines to ensure that the incident scene is secured and access is controlled.



In addition, “security support is provided to other response operations (and related critical locations, facilities and resources), emergency public information is provided, while protecting first responders and mitigating any further effect to the public at risk, and any crime/incident scene preservation issues have been addressed.”⁶

⁴ Emergency Response Guidebook, (2004): 358, 361, 358.

⁵ “Target Capabilities List, A Companion to the National Preparedness Goal, U.S. Department of Homeland Security,” (August 2006): 332.

⁶ Target Capabilities List, op. cit., p. 332.

Examples of tasks conducted by Perimeter Control personnel include, but are not limited to, the following:

- Controlling crowds and riots
- Controlling suspects and self defense
- Patrolling the vicinity and securing entry into and egress out of the hot or warm zones
- Lethal and non-lethal weapons handling
- Planning and communication
- Directing Traffic
- Assisting other emergency responders
- Defending physical critical infrastructure/key resources
- Establishing force protection
- Providing force protection for search and rescue personnel to allow them to operate safely
- Providing and planning for access to the site for emergency workers and other necessary and appropriate personnel
- Implementing and maintaining on-scene personnel identity management system
- Securing critical sites such as hospitals and medical supply distribution points

3) Tactical Operations – Tactical operations cover a wide range of tasks including typical SWAT operations necessary to neutralize situations, e.g., alleviating threats, apprehending suspects, searching and seizing. They carry out evacuations and rescue operations.



Tactical operations consist of removing affected victims and ensuring that “affected and at-risk populations (and companion animals) are safely sheltered-in-place and/or evacuated to safe refuge areas.”⁷ Tactical operators also conduct contamination and mitigation activities. Other examples of tasks conducted by Tactical operations personnel include, but are not limited to the following:

- Conducting tactical deployment
- Conducting surveillance of suspects
- Conducting an initial reconnaissance of the area
- Securing incident scene
- Conducting hostage negotiations
- Conducting tactical entry to disarm, detain, or otherwise render harmless suspects in accordance with the use of force policy/rules of engagement
- Executing search and seizure procedures
- Apprehending suspects
- Coordinating with appropriate unit and develop a plan of action

⁷ Ibid: 434.

- Using tactical operations teams to conduct searches of high priority unsecured sites to establish security and detain lawbreakers as necessary.

4) Crime Scene Investigation – Once the situation is secured, a crime scene investigation may be required to process the crime scene and conduct mortuary activities



prior to hazardous material (HAZMAT) clean-up. Crime scene investigations in a contaminated scenario include activities necessary to provide key forensic evidence for prosecutorial purposes, such as processing and removal of evidence and any remains of deceased victims. Tasks conducted by Crime Scene Investigation personnel include, but are not limited to:

- Following standard crime-scene procedures
- Recognizing and addressing onsite CBRN hazards
- Gathering, cataloging and preserving evidence for prosecutorial purposes and attribution
- Coordinating with critical resource infrastructure, key resource and private-sector officials to facilitate an investigation
- Recognizing indicators and warnings of potential terrorist-related activity during criminal investigations
- Coordinating Federal mortuary/morgue services
- Coordinating with local legal authority in mortuary affairs
- Documenting (photographing, measuring, obtaining witness statements) consistent with the Medical Examiner/Coroner's incident plan
- Gathering forensic evidence for fatality management operations
- Transporting remains to staging areas

5) Law Enforcement Personnel and Equipment Decontamination –

Decontamination teams are primarily responsible for clean-up and decontamination of victims, responders and equipment used during operations in contaminated environments. These operations require high levels of exposure protection in conjunction with fine motor control. Decontamination and site clean-up activities were primarily the responsibility of the fire services. In recent years, however, some law enforcement agencies have established decontamination capabilities for their own personnel and equipment in the event the fire service is overwhelmed or unable to decontaminate law enforcement personnel. Decontamination of victims is still the responsibility of the fire service.



As mentioned previously, each mission role operates within one or all of the isolation zones established during the initial threat characterization. The following figure graphically depicts the anticipated location of personnel within each mission role. In most cases, location of personnel will be dependent upon the type of threat and individual circumstances surrounding the response.

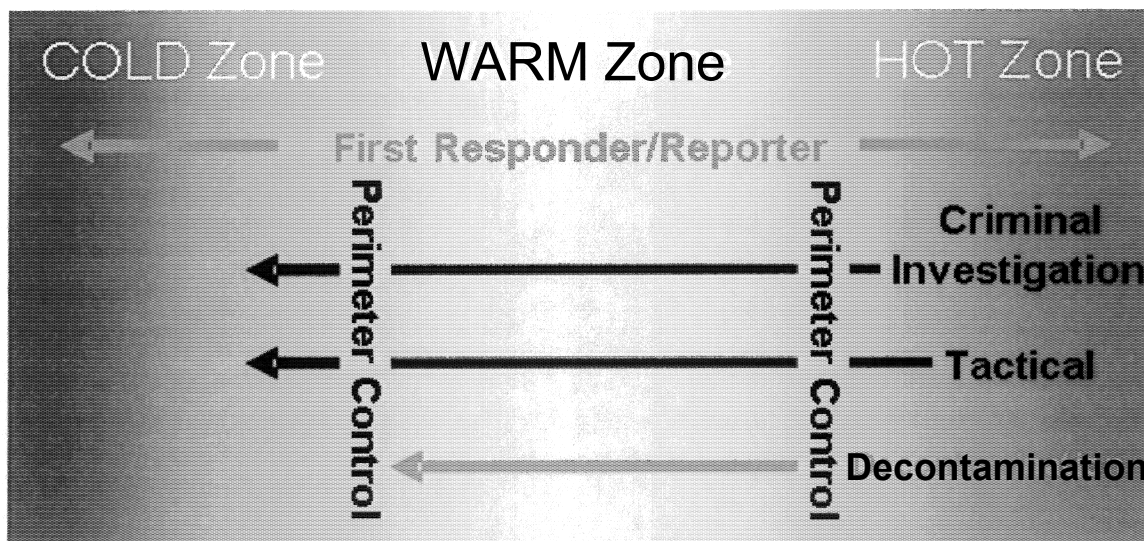


Figure 1 – Law Enforcement Personnel Mission Roles and Their Incident Operating Zone

As LE personnel progress closer to the hot zone, additional precautions must be taken to ensure protection at higher CB concentration levels. These considerations, along with the unique combinations of personal protective equipment (PPE) for each mission role were taken into account when examining the needs and requirements for LE CB PPE.

Thank you for your time and we look forward to seeing you in on the 15-16 May!

Appendix D – Protection Needs Matrices

Prioritization of Protection Needs: Duty Uniforms

Severity of Risk	Category	Frequent	Likely	Occasional	Seldom	Unlikely
	Catastrophic - May result in death	Gunshot ¹	Weaponized Chemicals		Weaponized Chemicals	
	Critical - may cause severe injury, major property damage, significant \$ loss	Bloodborne Pathogens ²	Industrial Chemicals ³ Puncture/Slash ²		UV Threat Protection - CUMULATIVE Environmental ² (frostbite example) Flame Protection	
	Marginal - May cause minor injury, illness, property damage, \$ loss	Industrial Chemicals ⁴ Bloodborne Pathogen ²				
	Negligible - hazards present a minimal threat to safety, health, and well-being of involved personnel	Environmental	UV Threat Protection - IMMEDIATE			
Risk Levels		Extremely High	High	Medium	Low	

DEFINITIONS:

Industrial Chemicals -lawfully held

Weaponized Chemicals - not lawfully held; WMD event

Biologicals - someone's blood or cut on someone's arm

UV Threat Protection – can be “cumulative” or “immediate”

¹ Gunshot-Catastrophic, but frequency depends based on population size and environment (urban/suburban)

² Have to view this from a geographic perspective, as threat probability changes based on location; is also event-driven

³Special considerations: Football season; small nuclear reactor on campus; accidental exposure as weapons degrade

⁴Hazardous incident risk/winds coupled with cargo accident rail/highways, risk of accidents (ex: Ann Arbor - surrounded by highways, gas lines that come through communities; super pipelines)

Prioritization of Protection Needs: Integrated Head Protection

	Category	Frequent*	Likely	Occasional	Seldom	Unlikely
Severity of Risk	Catastrophic - May result in death	Temperature Protection ¹		Impact - Crash	Impact - Ballistic	
	Critical - may cause severe injury, major property damage, significant \$ loss	Vision Protection ²	Hearing Protection; Impact - Objects ³			
	Marginal - May cause minor injury, illness, property damage, \$ loss					
	Negligible - hazards present a minimal threat to safety, health, and well-being of involved personnel					

Risk Levels

Extremely High

High

Medium

Low

*may vary based on geographic area...urban areas - more potential for frequency of occurrence than non-urban areas

¹ Can impact tactical mission if operator goes down; mental acuity suffers prior, and partner steps in to assist

² Vision Protection should be married to helmet design

³ should be modular to allow for flexibility, based on environment/mission

Appendix E – Description of Mission Roles

First Responder/Reporter:

This is typically the first LE officer at the scene who discovers the actual incident and/or reports back to command with details. The first responder/reporter is most likely to happen upon the incident inadvertently and either discover contaminated citizens or be contaminated themselves. Limited training and overall awareness are contributing factors. The most important action that the first responder/reporter can take is to protect his/her respiratory functions, retreat from the situation, and report back to command. Protection requirements could be limited to respiratory protection, such as an escape mask or air-purifying respirator (APR), for safe evacuation. Once the first responder/reporter calls in the incident, the officer is expected to retreat and await backup. Backup personnel who respond will fall under one of the remaining four mission roles.

Perimeter Control:

The perimeter control LE officer is responsible for ensuring that the overall situation is contained to eliminate the accidental exposure of persons in the vicinity. Order around the hot zone involves establishing a perimeter at the cold/warm zone line and then shifting the focus toward containing the situation. Containment could include, but is not limited to, the following tasks:

- Crowd disturbance and riot control
- Self defense and suspect control
- Vicinity patrol and security (e.g., regulating entry into and egress out of the hot zone)
- Lethal and non-lethal weapons handling
- Planning and communications
- Traffic direction
- Assisting other emergency responders
- Vehicle operation
- Physical mobility to contain a shifting threat

While engaged in these activities, perimeter control personnel could be exposed to off-gassing, liquid transference from other individuals, blood borne pathogens, and the like. Protection requirements for this mission role can include such equipment as an air purifying respirator (APR), a CB garment, gloves and footwear. The CB-protective ensemble must enable perimeter control personnel to complete their tasks safely and effectively by providing an ensemble that also resists cut and puncture, maximizes the range of motion and field of view, and provides dexterity and tactility.

Tactical Operations:

During a CB incident, tactical units are called upon when needed to neutralize a situation within the warm or hot zones. A situation could involve alleviating a threat, apprehending a suspect, rescuing a hostage or locating a potential secondary device. Tasks associated with such tactical operations include, but are not limited to, the following:

- Dynamic entry
- Clearings and evacuations
- Confined space operations (e.g., close quarters battle)
- Self defense and suspect control
- Rescue missions
- Vehicle assault
- Planning and communications
- Vicinity patrol and security
- Weapons handling
- Night and low light engagements

Tactical units are required to enter the contaminated area and perform all functions that a tactical team without a full CB-ensemble would carry out. As such, this mission role requires high levels of personnel and equipment protection (e.g., ballistic protection for self-contained breathing apparatus (SCBA) compressed air tanks), while satisfying high mobility, agility, and tactility needs. Covertness of the CB ensemble materials (e.g., color, noise) and equipment utilized (e.g., audible warnings) is also a concern.

Crime Scene Investigation:

Once the vicinity has been secured but prior to HAZMAT clean-up, a crime scene investigation may ensue to probe the scene and collect evidence. Tasks associated with crime scene investigation include, but are not limited to, the following:

- Evidence collection
- Sampling and monitoring
- Fine motor skills work (e.g., writing, fingerprinting, photographing, operating sampling equipment)
- Confined space activities
- Kneeling, crawling, bending, and lifting

The tasks associated with this mission role require high levels of personnel and equipment protection (e.g., puncture propagation tear resistance, burst strength) in conjunction with medium mobility and fine motor control. To complete their tasks safely and effectively, criminal investigators will require full body coverage in the form of a CB ensemble, SCBA, gloves (potentially multi-layered) and footwear.

Law Enforcement Decontamination:

Law Enforcement Decontamination teams are primarily responsible for clean-up and decontamination of the hot zone, but they also administer first aid. Tasks associated with this mission role require high levels of exposure protection in conjunction with potentially fine motor control. Law Enforcement Decontamination personnel require similar protection to that outlined in the NFPA standards, namely protection against high concentrations of vapor and liquid. Equipment requirements include a CB garment with protective hood and integrated visor, SCBA, gloves and footwear. Because the Law Enforcement Decontamination mission role for LE is very similar to fire fighter HAZMAT operations, the Law Enforcement Decontamination requirements and protection levels should align with those outlined in the NFPA standards.

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Appendix F – Ergonomic Scenario Descriptions

The following tasks/scenarios are proposed as evaluation items, to be used as timed tasks for gauging performance of the CB protective suits. The following assumptions underlie the tasks:

- Equipment mentioned is carried/can be carried within the suits by the LE personnel who would execute the tasks. Items should be logical and expected to be used for the particular task.
- Task order may need to be adjusted based on where and when the evaluation would take place (e.g., which building, outdoors/indoors, etc.), or to improve the scenario's flow.
- Distances can be lengthened or shortened as needed.
- The equipment is available to during the evaluation.
- Before any tasks are finalized, a dry run is needed to ensure that tasks can be completed in a reasonable amount of time, without causing undue stress on the subjects wearing CB ensembles and masks.

All of these tasks were chosen with the intention that they can be easily learned by non-law enforcement test participants.

Mission: Perimeter Control

- Items carried/worn: roll of caution tape, radio (with speaker-microphone), first aid kit (or placed nearby), small notebook, pen or pencil, flashlight, weapon and holster (9mm or other handgun assumed).
- Tasks
 1. From starting mark, run 50 feet to area to be controlled.
 2. Secure caution tape around one item (doorknob, stake, etc.) and roll out at least 10 ft of tape before securing the other end. Tape should be approx 4 ft off the ground.
 3. Run back 50 feet to starting mark.
 4. Use radio to call command post. Write down instructions received via radio from command post.
 5. Retrieve notebook and pen. Draw rough sketch/map of scene.
 6. Walk back to caution tape, stepping over a guardrail on the way.
 7. Duck under caution tape and walk 20 ft beyond tape to 'victim' (dummy). Grab dummy under the arms and remove from cordoned-off area.
 8. Once in safe area, render first aid to victim by wrapping upper arm with bandage.
 9. Stand up and repair any damage to caution tape caused from dragging dummy to safe area outside perimeter.
 10. Walk back (50 ft) to starting area.
 11. Take out flashlight, turn it on, and pan across area beyond caution tape. Stow flashlight.
 12. Draw weapon from holster, hold upward "at attention" with two hands for 10 seconds, then re-holster weapon securely.
 13. Run approximately 10 ft to other end of caution tape.

14. Re-draw weapon, aim, speak appropriate commands, and simulate firing two shots. Remove magazine from weapon, stow it, remove new magazine from belt and insert new magazine into weapon. Re-holster weapon.

Mission: Tactical Operations

- Items carried/worn: appropriate weapon, mock “flash-bang” grenade, handcuffs, grappling-type hook with approximately 25 feet of strong rope attached to the hook (optional), ram (optional).
- Tasks:
 1. Walk sideways along wall for 20 feet, stopping at closed door that opens in (away from approaching individuals).
 2. At this point, one of two options can be used (options allow actual removal/damage to the door if allowed during testing):
 - a. Open door from position aside door (using door handle/knob).
 - b. Force open door with ram carried to door by subject.
 3. Toss a “flash bang” grenade into doorway from position aside door.
 4. Wait 10 seconds, and then enter doorway with weapon drawn and ready, dropping immediately to a squatting position. Mock aim and fire the weapon.
 5. Enter area beyond doorway.
 6. Speak appropriate verbal commands to dummy lying on floor 10 feet inside door, while keeping weapon trained on dummy.
 7. Approach dummy.
 8. Kneel next to dummy. Holster weapon. Use handcuffs to restrain the dummy’s arms behind its back.
 9. Drag dummy out the door by grasping it under the arms.

Mission: Crime Scene Investigation

- Items carried/worn: paper bag, tweezers, digital camera, fingerprint kit (brush, powder, tape)
- Tasks:
 1. Walk 25 ft to crime scene. On the way, subject will step over/around several “X” marks on the floor placed 2 ft apart and on different sides of the pathway. In addition, a narrow hallway will be used as part or all of the 25 ft available; If not available a pathway will be marked on the floor and the subject must walk within the lines.
 2. Approach a table with a 2-inch square marked off at the far side of the table.
 3. Bend forward as needed to use fingerprint kit to powder, dust and tape the print, and then remove the tape and secure the print on the tape.
 4. Move 4 ft to the side, and locate small item (e.g., pin from O’Conner test) on floor. Squat and pick up item with tweezers. Place item in paper bag. Secure paper bag.
 5. Stand up, move 6 ft further to same side. Squat down, retrieve digital camera and take photo of “object” on floor.
 6. Stand, secure all items collected or used as necessary, move 6 ft backwards, then turn around and walk back to starting point.

Appendix G – Representative Sample of Purchase Order
(Provided by ABQ PD)

Albuquerque Police Department

UNIFORM VOUCHER

Assigned To: _____

Man No. _____

Blauer

8600Z	_____	29.95
86002	_____	26.95
86002W	_____	26.95
8650	_____	25.95
8652W	_____	25.95

Elbeco

Z314	_____	28.95
Z9314	_____	28.95
Z3314	_____	25.95
Z29814	_____	25.95
E314	_____	25.95

Horace Small

HS1150	_____	28.95
HS1250	_____	25.95
HS2149	_____	25.95

511: Must have additional
written authorization to purchase.

Please indicate which authorized
manufacture's part numbers were
purchased. Voucher good for one
shirt and one trouser.

Received by: _____

Date: _____

Note: Voucher is only valid for the

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Appendix H – Duty Uniform Integration Issues Survey Results

The following tables show the actual prioritized integration issues written by each participant on the duty uniform needs survey. These issues are ordered by category, and the ranks shown represent the issue's ranking determined by that participant.

Rank	Comfort
1	Comfort of wearer
1	Comfort/range of motion
1	Comfort - The uniforms must be comfortable because we live in them (example: Kevlar vest)
2	Comfort - uniform is comfortable, therefore allowing officers to perform their required duties
2	Bulkiness
2	Comfort and fit
3	Comfort – coolmax
4	Mobility – jackets
4	Comfort
4	Comfort
5	Weight vs. protection

Rank	CB Protection
1	Protective fabric (biological)
2	Bio/blood borne pathogens
2	Protection of blood borne pathogen (i.e. blood, saliva, sweat, etc.)
2	Fluid barrier
3	Splash protection: blood, saliva, urine, etc.
4	Biological
4	Splash protection: chemicals industrialized, exp - battery acid
5	WMD/Industrial chemicals
5	Fabric protection from UV
2	Protection: Chem, Biol, Static, Thermal

Rank	Appearance
1	Functionary vs. image
2	Function
1	Appearance

Rank	Appearance
1	Appearance
1	Protection vs. appearance. Protection must become a priority.
3	Functionality vs. look (appearance)
3	Appearance/image

Rank	Environmental
1	Environmental
2	Cold weather (jacket)
2	Cold weather gear vs. uniform shirt/pants (tucked in)
2	Weather - Environmental protection: heat and cold
3	Thermal
3	Bulky cold weather gear (outer)
3	Body armor with heating/cooling maintenance issues
4	Environmental protection

Rank	Access to Equipment
1	Ability to access all your equipment
1	Operability vs. weight and accessibility. If you can't carry/reach the tool, it's useless.
2	Equipment access with jacket worn
2	Access to equipment
3	Access to Sam Browne belts
3	Unit accessibility to tools on Sam Browne belt
4	Storage or pockets for storage

Rank	Durability
1	Puncture protection
1	Edge WPN issues/puncture
3	Fabric must be durable for long-term use
3	Puncture / bullet resistance
3	Protection
4	Puncture/slash
5	Puncture resistant - wear
5	Dry cleaning / laundry
5	Durability

Rank	Proper Fit
4	Fabric flexibility to allow "layering" of clothing and body size fluctuation
4	Mobility
4	Use of ballistic vest over/under uniform
5	Layering of clothing

Rank	Compatibility
1	Integration between rain gear and uniform

Rank	Other
2	NIMS issues

Rank	Alternate 'suit'
3	Alternate "jump-suit" which could be trunk carried in car for CBRNE environment.

Rank	Load Capacity
5	Load bearing / carry additional gear

Rank	Conductivity
5	Electrical threats: taser, live wires

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Appendix I – IHP Integration Issues – Survey Results

The following tables show the actual prioritized integration issues written by each participant on the duty uniform needs survey. These issues are ordered by category, and the ranks shown represent the issue's ranking determined by that participant.

Rank	HP to CBRNE Gear Fit
4	Helmet vs. Chemical/Bio PPE
1	Fit/security (CBRNE gear)
1	Helmet vs. respiratory protection/seal
2	Integration w/resp. protection
2	H.P. that can conform/integrate w/PPE
2	Helmet melding to respiration system
2	Respiratory
2	Respiration
2	Helmet vs. Respiratory protection suspension and security
3	Vision Integration, especially with PPE, SCBA
3	SCBA or APR
4	Respiration/Gas Mask
4	Proper fit with APR and SCBA
5	Gas Mask
1	PPE/SCBA and Helmet

Rank	Communications
1	Communications
1	Communications
2	Communications integration mostly SWAT/Tactical
2	Communications
2	Communications and Helmet
3	Communications
3	Communication verbal and radio
4	Communications
4	Communications
4	Communications

Rank	Suspension- Harness
1	Suspension/Harness
1	Suspension/securing
1	Suspension/securing
1	Suspension security
1	Suspension System
3	Suspension and Security of Helmet
3	Harness

Rank	Eye Protection
2	Eye Protection
2	Vision
2	Eye Protection
3	Eye Protection
3	Eye Protection
3	Eye Protection
3	Eye Protection
4	Visual Protection
4	Vision

Rank	Standardization of Add-Ons
1	Modularity different add-ons /standardization of platforms
1	Modular design to match helmet to purpose (i.e. night vision for swat vs. illuminator for bomb tech)
4	Modular approach to a helmet platform
5	Support light source
5	Modularity
5	Additional Lighting Systems

Rank	Impact Protection
1	Crash protection (impact)
2	Impact Protection
3	Impact Blunt/Strike trauma resistant

Rank	Ballistic Protection
1	Ballistic Protection
2	Impact (Bullet) Resistant

Rank	Hearing Protection
3	Hearing Protection /Communications
5	Hearing Protection
5	Hearing Protection
5	Hearing Protection/Amplification
5	Hearing

Rank	HP to APR Fit
1	H.P. that integrates w/ APR, dual use for rapid deployment(ballistic capability) and crowd control

Rank	Environmental
3	Ventilation
4	Temperature Control

Rank	Weight
2	Weight Concerns

Rank	HP Fit
4	Fit

Rank	Adaptability (i.e., from Bike to Riot gear)
5	Adaptability (i.e., from Bike to Riot gear)

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Appendix J – Mission Role Task Matrices

Mission Role Task Matrix: Scottsdale, Arizona

Tasks	Mission Roles		
	Perimeter Control	Tactical Operations	CSI
Weapons Proficiency			
Weapons Transition/Retention			
Operate Equipment			
Close Quarters Battle			
Ground Fighting – Hand to Hand			
Fire and Movement			
Engaging Moving Targets			
Night/Low Light Engagement			
Self Defense			
Suspect/Victim Control			
Traffic Direction/Crowd Control			
Evacuation			
Site Security			
Assistance of Other Responders			
CBRN Sampling/Monitoring			
CBRN Evidence Collection			
Vehicle Operations			
Communication – Radio and in person			
CB Perimeter Characterization			
Donning/Doffing			
Officer/Civilian Rescue			
Dark Gray shading denotes areas of agreement		Light Gray shading indicates areas of disagreement	White space indicates that the task is not appropriate to the mission role

Mission Role Task Matrix: Arlington, Virginia

Tasks	Mission Roles		
	Perimeter Control	Tactical Operations	CSI
Weapons Proficiency			
Weapons Transition/Retention			
Operate Equipment			
Close Quarters Battle			
Ground Fighting – Hand to Hand			
Fire and Movement			
Engaging Moving Targets			
Night/Low Light Engagement			
Self Defense			
Suspect/Victim Control			
Traffic Direction/Crowd Control			
Evacuation			
Site Security			
Assistance of Other Responders			
CBRN Sampling/Monitoring			
CBRN Evidence Collection			
Vehicle Operations			
Communication – Radio and in person			
CB Perimeter Characterization			
Donning/Doffing			
Officer/Civilian Rescue			
Dark Gray shading denotes areas of agreement	Light Gray shading indicates areas of disagreement		White space indicates that the task is not appropriate to the mission role

Appendix K – Chemical/Biological PPE Issues – Survey Results

The following tables show the actual prioritized integration issues written by each participant on the duty uniform needs survey. These issues are ordered by category, and the ranks shown represent the issue's ranking determined by that participant.

Rank	Helmet	
3	Helmet fit	<i>Helmet Fit</i>
1	Ballistic head gear integration with APR	<i>Helmet to APR Fit</i>
1	Compatibility of equipment such as helmets and masks etc.	<i>Helmet to APR Fit</i>
1	Mask and helmet and commo	<i>Helmet to APR Fit</i>
1	Integration helmet	<i>Helmet to APR Fit</i>
2	Masks with helmet	<i>Helmet to APR Fit</i>
2	Mask/helmet	<i>Helmet to APR Fit</i>
1	Helmet, APR, Suits, Integration	<i>Helmet to APR to Suit Fit</i>
1	Nothing Built from Ground-Up For Police First Responder - Mask, Suit, and Helmet Built/Fit for Integration	<i>Helmet to APR to Suit Fit</i>
4	Helmet, Voice, Comm Integration	<i>Helmet to Communications Fit</i>
4	Communication issues	<i>Helmet to Communications Fit</i>
5	Hearing issues associated with helmet on head etc.	<i>Helmet to Communications Fit</i>
1	Helmet / SCBA integration	<i>Helmet to SCBA Fit</i>
1	SCBA use with tactical equipment; team just began training with them (2 weeks ago)	<i>Helmet to SCBA Fit</i>
1	Integration between SCBA and helmets	<i>Helmet to SCBA Fit</i>
1	Helmet with SCBA, APR mask	<i>Helmet to SCBA Fit</i>
1	Helmet properly fitting with APR or SCBA mask	<i>Helmet to SCBA Fit</i>
2	SCBA Helmet / Radio Communication integration	<i>Helmet to SCBA Fit</i>
4	SCBA masks with helmets	<i>Helmet to SCBA Fit</i>

Rank	Suit	
3	PPE suit inability to carry miscellaneous tools (no pockets)	<i>Suit Design</i>
1	Suit fit	<i>Suit Fit</i>
2	PPE sizing. Too generalized.	<i>Suit Fit</i>
2	CBRNE Environment vs. Hostile Action Environment (Suit that can be fought in)	<i>Suit Fit</i>

Rank	Suit	
2	Fit of suit	<i>Suit Fit</i>
3	Actual comfort and sizing of PPE with job performance requirements	<i>Suit Fit</i>
3	Range of motion with SWAT uniform equipment (weapons, RAMS)	<i>Suit Fit</i>
4	Proper fitting PPE	<i>Suit Fit</i>
4	Footwear not conducive to tactical movements	<i>Suit Fit</i>
4	Footwear. Improper fit for WMD/Clan Lab	<i>Suit Fit</i>
5	Glove/shoes from protective suits to regular uniforms	<i>Suit Fit</i>
5	Footwear	<i>Suit Fit</i>
2	PPE suit. Does not fit properly for tactical OPS	<i>Suit Fit to Tactical OPS Gear</i>
3	Level A suit with tactical equipment	<i>Suit Fit to Tactical OPS Gear</i>
2	Suit Joints (Chem Tape)	<i>Suit Joints</i>
4	SCBA/Chem suit mobility integration	<i>Suit to SCBA Fit</i>

Rank	Lack of LE Standards
5	Support from other resources (Fire, EMS, FEMA/MEMA)
1	Use of equipment governed by NFPA standards for LE
1	Fire equipment made into police equipment
3	Making equipment specific to LEO such as fire helmets etc
4	FD equipment used for police role...now more important to me
5	Standardized regulations for LE with regard to OSHA

Rank	Body Armor Integration
2	Ballistic protective vest integration with PPE
2	Integration between Chem Bio suits and ballistic suits (bomb suit)
2	Body armor with PPE suit and SCBA
3	Vest with Suit Use
3	Body armor not in design of PPE suit

Rank	Durability
4	Durability of PPE with job performance requirements
1	Having a PPE suit strong enough to handle day to day usage/storage
4	Gear storage
3	One time use

Rank	Mask
2	Mask fit <i>Mask Fit</i>
5	Suits with SCBA or PAPR (straps) <i>Mask to SCBA Fit</i>
5	Weapon systems and masks <i>Mask to Weapons Fit</i>
2	Vision <i>Mask: Vision Restriction</i>

Rank	SCBA
3	Respiration <i>SCBA / PAPR/ APR Fit</i>
3	SCBA / Voice (victim/suspect/friendly) communication <i>SCBA to Communications Fit</i>
3	CQB Communications to suspect/victim <i>SCBA to Communications Fit</i>

Rank	Training
2	Training as far as how to do things safely such as movement
2	"Mind-set" - it can happen here.

Rank	PPE System Compatibility
3	Ground-up design of PD equipment is a <u>MUST</u> . "Over all" package must be integrated to meld together.
3	Integration between Chem Bio suits and load bearing equipment i.e. un belts

Rank	Appearance - Threatening
3	CBRNE suit that does not excite/terrify crowd (for large event/suspicious package response)

Rank	Decontamination of Weapons
4	Decon of critical gear (i.e. vest and weapons)

Rank	Environmental
5	Heat exhaustion. Need cooling inside PPE